IN THIS ISSUE—DESIGNS OF AIRPLANE RADIATORS

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The Automobile and Automotive Industries

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Airplane Radiator Construction

Radiating Surface Required for Engines of Different Horsepower—Arrangement of Radiators on Airplanes

By P. M. Heldt

EVENTUALLY airplane engines, and especially those of moderate output, will no doubt be air cooled, as air-cooling results in a reduction of weight, and, besides, the conditions for air cooling an engine are most favorable in aerial work. At the present time revolving engines are successfully air cooled and the same cooling system has been employed for the radial type of engine. In the present vertical and Vee engine, however, which types are used in by far the greatest numbers, water cooling seems to be necessary for the best results.

Owing to the necessity of extreme weight economy the radiator of an airplane must be designed along different lines from those of an automobile radiator. For instance, the radiator and cooling water of an average 40-horsepower automobile will weigh in the neighborhood of 100 lb., or 2½ lb. per horsepower. This is as much as the weight of the whole engine without cooling system in the larger sizes for airplane work, and as the cooling system should weigh only from one-sixth to one-fifth as much as the engine, it is plain that great refinement in design is necessary in the airplane radiator.

Radiators are referred to in the specifications for the U. S. Army primary training machines. However, no detail restrictions are imposed, it being merely stipulated that the radiators "shall be of approved design and so constructed as to be proof against the action of vibration."

Gage of Stock Used

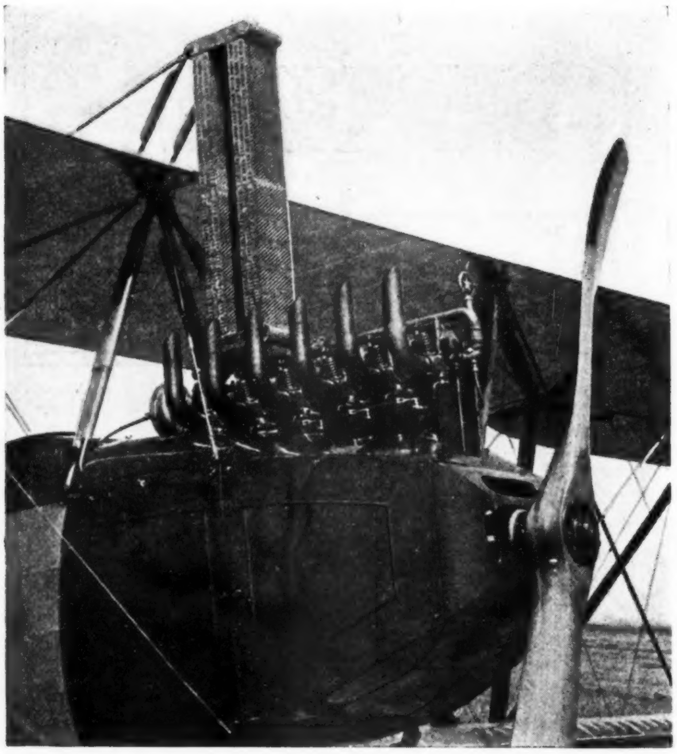
The first requisite in order to insure a light radiator is the use of thin stock. Abroad, stock 0.10 millimeter or 0.00394 inch in thickness is generally used for airplane radiators and in this country 0.0035 inch stock has been used. Copper has an advantage in having the highest thermal conductivity, but where the material is so extremely thin a somewhat harder met·l is desirable, and special bronzes are used. The extreme thinness of this metal is shown by the fact that 6 sq. ft. of it weighs only 1 lb.

In automobile practice it is customary to allow 6 sq. in. of cooling surface per B.t.u., to be disposed of per minute. Now, it can be seen by looking at almost any airplane that the radiator is quite small in view of the high horsepower of the engine. Almost all of the conditions in airplane work favor engine cooling. There is first the high velocity draft of air through the radiator induced by the speed of the machine. Next comes the fact that the air temperature in the higher altitudes where airplanes mostly fly are comparatively low. On quite a few planes the radiators are set so that the air passing through them encounters no other resistance than that of the radiator passages, not having to pass through a restricted passage around the engine. Finally, as the exhaust is usually directly into the atmosphere the percentage of the total heat going into the cooling water is probably somewhat reduced as compared with cases where a muffler is used.

Thermal Calculations

It appears that in airplane work an allowance of 1.6 sq. in. per B.t.u. to be disposed of gives satisfactory results. Thus if there are 60 B.t.u. to be disposed of per minute per brake horsepower, we must have 96 sq. in. of cooling surface per horsepower, or 0.66 sq. ft. per horsepower.

It is not far from the mark to assume that 28 per cent of the heat liberated by the combustion of the fuel in an airplane engine has to be dissipated by the radiator. This is somewhat less than the percentage going into the jacket water in block test, but the direct exhaust and the excellent cooling facilities of the engine itself will reduce this percentage. The brake horsepower of the engine is equivalent to about 20 per cent of the heat value of the fuel, hence the heat to be disposed of by the radiator is equal to about 1.4 times the heat equiva-



Method of mounting radiator on Wright-Martin airplane

lent of the brake horsepower. One brake horsepower is equal to 33,000 foot-pounds per minute and one thermal unit has 778 foot-pounds, hence one horsepower is equivalent to 33000/778 = 42.4 B.t.u. per minute. As the heat to be disposed of by the radiator is 1.4 times this it amounts to about 60 B.t.u. per minute per horsepower.

Thus with a 100-horsepower engine the radiator would have to dissipate 6000 B.t.u. per minute, and as 1.6 sq. in. radiating surface is required for every B.t.u. per minute, 9600 sq. in. = 67 sq. ft.

Radiator design for automobiles is limited by considerations of cost. While cost may also be a factor in radiators for airplanes the limitations certainly are not nearly so close.

As already pointed out, the conditions of operation of the radiator on an airplane are particularly favorable. It is fully exposed to the air current created by the motion of the plane. This current affects every part of the radiator equally, and the whole of the radiator core, therefore, will operate at uniform efficiency. High air speed through the radiator is assured. Another thing required to insure high radiator efficiency is high water speed. If we assume that 60 B.t.u. have to be dispersed by the radiator per engine horsepower per minute and that the water in the cooling circuit passes through a range of 30 deg., which is a rather high figure, 72 lb. of water must be passed through the radiator per minute for every horsepower developed in the engine. This, of course, does not fix the amount of water to be carried, as the speed of the water may be greater than once around the circuit a minute. The amount of water is rather determined by the capacity of the jackets, the radiator and the connections.

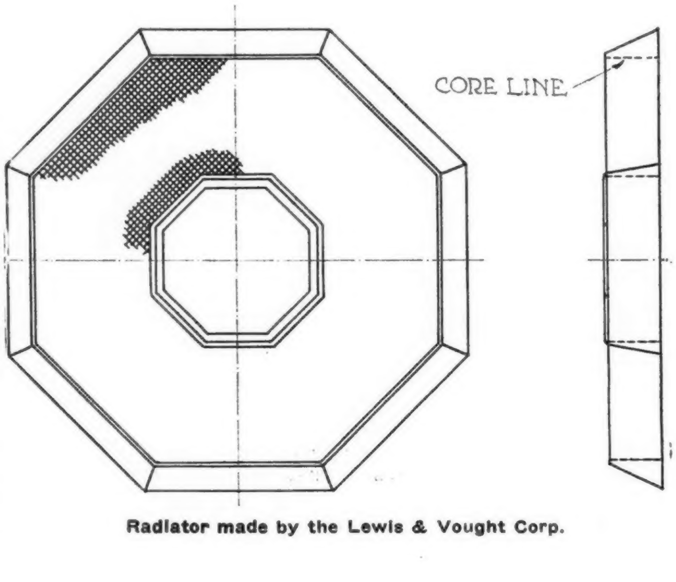
Most of the single-engine tractor type airplanes have the radiator in front of the engine at the forward end of the fuselage. Unfortunately in this case quite a proportion of the core is shaded by the propeller and rendered practically ineffective. Strictly speaking, since the propeller revolves and does not cut off any particular part of the radiator from the air current, the capacity of the whole radiator will be reduced in a given proportion owing to the interference with the air current through the radiator by the propeller. Some makers place the radiator above the engine between the fuselage and the upper plane. In this position it is certainly the most efficient from the point of view of effective cooling alone, but inasmuch as it introduces additional wind resistance area the gain in cooling efficiency has to be paid for in increased head resistance. In other types of airplanes the radiator, instead of being placed with its plane perpendicular to the axis of the machine so as to strike the air currents head-on, is divided into halves and placed on opposite sides of the fuselage, lying flat against the side of the latter. In this case the amount of air coming in contact with the radiator in unit time is reduced, as is the resistance to the motion of the plane due to the radiator.

Much Development Work Under Way

From an inquiry directed to all the prominent radiator makers of the country it appears that most of them at present are in the midst of development work looking toward the production of an efficient airplane radiator, and few have anything definite to offer. Most of these makers have built airplane radiators in the past, but it is generally realized that the war has advanced airplane construction in practically all of its branches to a point where constructions that served for experimental machines several years ago will not do.

Among the American manufacturers of radiators who have paid a good deal of attention to airplane radiators is the G. & O. Mfg. Co., New Haven, Conn. In its general work it uses three different core constructions, but one of these, the Mercedes type, with wire spacers between tubes, is unsuitable where extreme weight economy is essential. All are of cellular or honeycomb type.

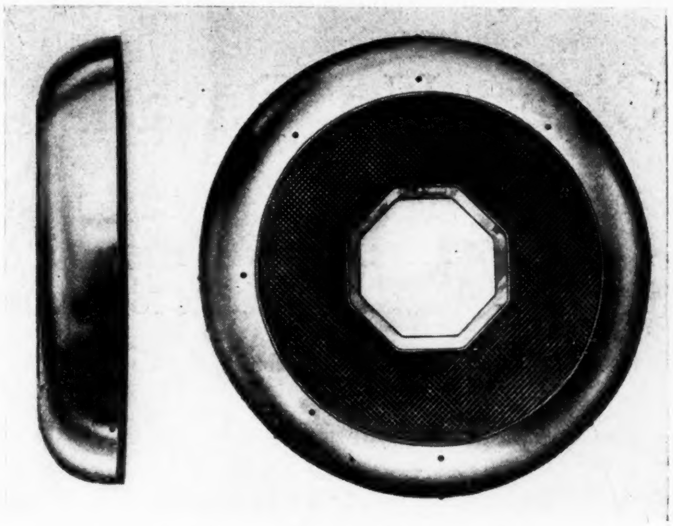
There seems to be a tendency on the part of the airplane designers to incorporate liberal scrolls and curves in the outline of the cooling core, and owing to the manner in which radiator tubing has to be stepped in the course of construction, around the periphery of the core, it has required considerable solder in assembling the core with the casing. One of the most practical designs from this point of view is that shown by the inclosed cut. This is the radiator used on the Vought airplane, manufactured by the Lewis & Vought Corp., of Long Island City, and is somewhat similar to the French "Spad." The radiator proper is octagonal in outline and is roughly shown in the accompanying sketch. It is bolted inside of a German silver shell, which conforms with the stream lines of the front end of the body.



Radiator made by the Lewis & Vought Corp.

It will be noted that the core outline, as well as the opening for the propeller shaft, is composed of straight lines, and this allows of a very practical and close seam between the radiator core, the inner crank hole tank and the outer tanks. It also insures that a maximum of the metal in the radiator is adapted to direct radiation.

It is hardly likely that radiators of any other type than those having only direct radiating surface, with water on one side and cooling air on the other, will be used for airplane work. It is true that indirect radiating surface will dissipate heat from both sides of the sheet, but as this sheet is not in contact with the hot water it will be of considerably lower temperature than the latter, which will reduce the temperature difference between the radiating surface and the surrounding air and hence the dissipation of heat.



Lewis & Vought radiator and shell

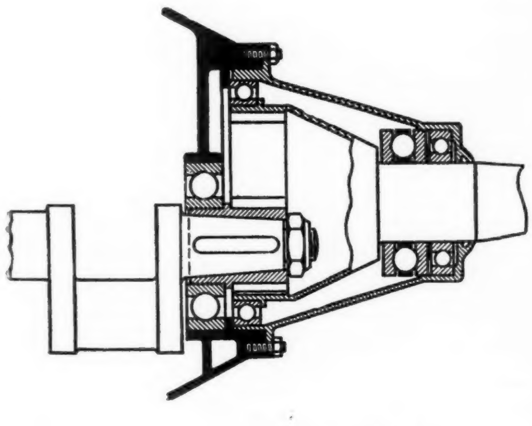
Design of Reduction Gearing for Airplane Engines

THE design of reduction gearing for airplane engines, though apparently a very simple matter, involves considerable difficulty, owing to the enormous powers that must be transmitted and the limitations on the bulk and weight of the gearing. The bearing pressure resulting from the reaction between the teeth of the gears is especially great if the gear overhangs the bearing. For instance, if 150 hp. has to be transmitted at 1500 r.p.m. through a pinion of 4½ in. pitch diameter, the tooth pressure produced is equal to more than 3000 lb. This is not an instantaneous pressure like that on the crankpin bearings of an engine at the moment of explosion or at the beginning of the inlet stroke, but a continuously maintained pressure. The bearings therefore must be very rigidly supported and must be of large carrying capacity. Ball bearings are almost exclusively used, owing to the space economy they effect and the consequent saving in weight.

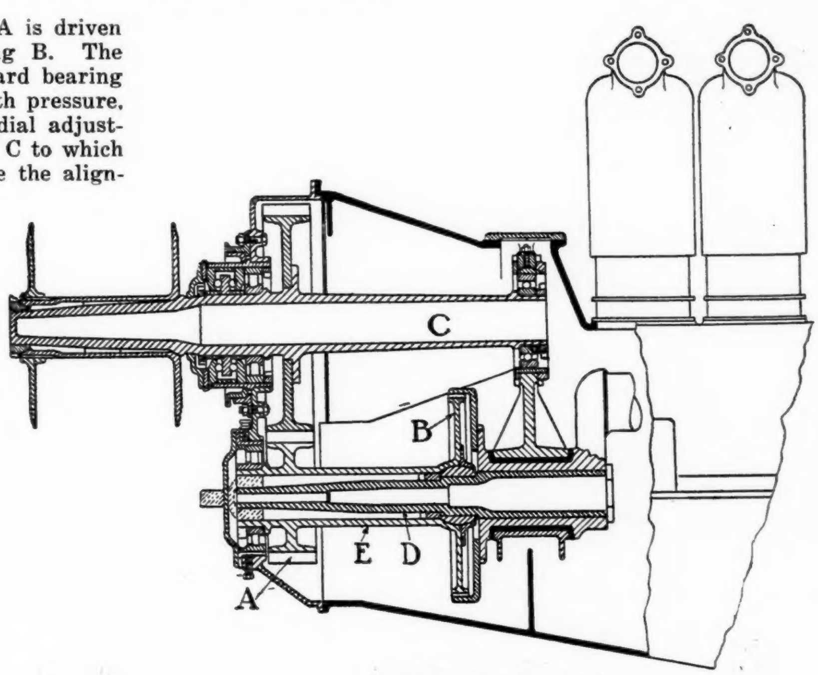
Various designs of reduction gears have been worked out abroad and have become known through the publication of patents issued on them. On this page is shown a gear patented by H. F. Royce of the Rolls-Royce Co. Mr. Royce's objects are to provide a flexible driving means between the crankshaft and the gear and convenient means for aligning the driving means. The further object is to reduce the load on the end bearing of the power shaft and the bending stresses on the power shaft due to the tooth pressure of the gearing.

In the gearing referred to the driving pinion A is driven from the crankshaft through a flexible coupling B. The pinion is mounted in such a way that an outward bearing takes the greater part of the load due to the tooth pressure, and this bearing is provided with means for radial adjustment, as are the bearings on the secondary shaft C to which the propeller hub is fitted. In order to facilitate the alignment of the crankshaft pinion, an extension D is provided on the crankshaft which passes through the hollow pinion shaft E, the arrangement being such that space is left between the crankshaft extension and the hollow pinion shaft to permit of the insertion of a gage or test piece.

Another design of reduction gear has been patented by M. Birkigt of the Hispano Suiza firm. In this use is made of internal gearing, and a very neat and compact construction results. In this connection it is also well to remember that internal gearing is inherently somewhat more efficient than spur gearing, so that a slight saving in power is probably secured. The crankshaft carries a pinion which meshes with an internally toothed ring on a cup formed integral with the propeller shaft. This cup is supported directly over the internal toothed ring in a ball bearing which is mounted in a carrier. This same carrier extends to the propeller hub seat and supports the radial and thrust ball bearings of the propeller shaft proper. The large end of the carrier extends into a counter bore in the end of the crankcase and is turned slightly eccentrically to the seats for the ball bearings, so that by rotating it a very fine adjustment of the mesh can be secured. A large number of equally spaced bolts are used to bolt the carrier to the crankcase, and the degree of adjustment obtainable is determined by the angular distance between adjacent bolts.



Birkigt's reduction gear



Royce's reduction gear

Clean-Up Details of Standard Trucks

Last Stages in Drafting on Class B Nearing Completion—Engines for Experimental Chassis Half Built in Six Factories—Schedule Calls for Production in January

By A. Ludlow Clayden

WITHIN a few weeks the first of the standardized military trucks will be on the road, and within a very short time engines for Class B will be on the block. There remains to-day no designing to be done, save perhaps for a few accessory attachments. For example, some standard lamps of a special sort are being perfected on paper. Practically every important part is already under way in factories.

Present plans call for ten experimental engines and two complete Class B trucks. Continental, Buda, Hercules, Hinkley, Wisconsin and Waukesha are building engines, helping each other out on parts; Continental will make all the cylinders, for example. Of the two chassis, one will be assembled by Gramm-Bernstein and one by Selden, these two firms buying the parts themselves so as to avoid a great multiplicity of official orders for small pieces. The schedule calls for the chassis in October, and it seems likely that it will be possible to do fully as well as is hoped.

It is now possible to review the whole design coherently, though to do so will call for some recapitulation of facts already published in AUTOMOTIVE INDUSTRIES.

Firstly, the wheelbase is 160 in., the engine 4¾ by 6 in., 424 cu. in., the transmission a four-speed, amidships, the clutch a dry disk inclosed in the bell housing, and the rear axle a worm-drive, full floating type. Steering is by worm and worm wheel. Fuel feed is by gravity from a 15-gal. tank on the dashboard, there being a 16-gal. reserve tank under the seat, and ignition is double, with battery and magneto systems entirely separate. The frame is pressed steel, of channel section, and quite straight; the springs are almost perfectly flat, and Hotchkiss drive is used. Both brakes are internal and on the rear axle. Taken as a whole, there is nothing peculiar in the design except its unusual strength for the load capacity. It is really a 5-ton truck, and will probably weigh about 8500 lb. for the chassis with wheels and tires but without any body parts.

Engine a Masterpiece

Probably there has never been a better designed engine. Seeing the collaboration upon it, the design ought to be quite above the normal, and the careful detail is not done justice in a mere word description. Three particular points have been kept in mind throughout—first, the best possible lubrication; second, the provision of a water jacket reaching every smallest point likely to become hot; and third, rigidity without excessive weight. Additional points of note are a conspicuous cleanliness of exterior and an entirely inclosed governor mechanism of great simplicity which positively cannot be tampered with when once set.

The cylinders are cast in pairs, with detachable heads, each head being secured by thirteen studs. The two spark plugs are located side by side, *with* a water space between their bosses, right in the center of each cylinder, and as an example of careful detail the water outlet pipe, which is a brass built-up proposition, is offset enough to allow easy access to both plugs with a socket wrench. All the combustion space is in the head castings, the tops of the blocks being faced flat, the valve heads standing up a little from this surface. All valves have ports 2⅛ in the clear, and are tungsten steel head and stem, with 60-lb. springs. The diameter of 2⅛ is maintained on the exhaust ports right out to the manifold flange, but the intake is restricted to 1 11/16 in. at the flanges, the desire being to maintain a fairly high gas velocity right up to the moment of entering the cylinder. The cylinder walls are 5/16 in. thick. Water completely surrounds each cylinder and each valve seat, the valve ports never approaching so close as to raise any doubt as to the maintenance of jacket space between them and their adjacent cylinders. Intake ports are twinned, coming to a single flange outlet on each cylinder block.

Following up the security assured the heads by the use of 13 studs ½ in. in diameter, each block is attached to the crankcase with seven ¾-in. studs, the base flange being ½ in. thick at the thinnest points and 1 in. thick at each holding-down stud boss. The water inlet flanges, which are on the sides of the blocks remote from the manifolds, are 1 3/16 in. in diameter, and the outlets on the head castings are the same size. The holes connecting the cylinder and head jackets are so arranged that only a small flow is possible on the side away from the valves, the greater body of water being thus compelled to pass around the valve ports. The outlets for the water are close to the spark-plug bosses, entirely preventing any accumulation of steam in that vicinity.

The crankcase is all aluminum, including the bell housing and the oil pan. The bearings are very rigidly webbed, and the whole case is as stiff as could well be imagined. At the rear end there are two deep arms which act as the rear supports. Here the diameter of the case and of the flywheel housing is such that the arms are extremely short, and they are formed in such a way that the top of the bell makes a complete arch construction from tip to tip of the arms, so adding considerably to their natural strength. The front support is a spigot on the front-end cover, turned and held in a swivel collar on a dropped cross member of the frame, so giving a three-point support with sufficient flexibility to counteract all stresses in the main frame.

Lubrication Entirely Pressure

Complete pressure lubrication is used, even to the extent of feeding the wrist pins by means of tubes secured to the connecting-rods. Oil is fed to the three main bearings, thence by straight holes diagonally to the

crankpins, and thence to the wrist pins. The pump is in a well at the extreme rear right end of the crankcase oil pan, where it is separated from the rest of the system by a wall that prevents oil falling from the bearings from entering without first passing through the screening system, which is very elaborate.

The forward portion of the pan is very shallow, so as to give great clearance over the front axle, and sloped toward the deep rear end, which contains all the oil. The top of this sump is closed by a sheet of thin steel having in the center a funnel reaching nearly to the bottom of the sump. This funnel is surrounded by a wall reaching nearly up to the sheet steel just mentioned, so that oil has to pass down the funnel and then up again over the wall, the chamber into which the funnel discharges being thus always full. This is the settling chamber, designed to catch all particles of carbon and impurities and prevent them from passing on into the main oil reservoir. However, after passing over the wall beyond the funnel there is still a large screen of wire mesh to be passed, and another screen is used on the actual pump intake. This makes the oil circuit from pump to bearings, to settling chamber, to first screen, to second screen, and then round again. The settling chamber can be drained by a plug in the bottom, and draining it does not affect the main body of the oil, so very little need be wasted.

Has Roller Tappets

The tappets are housed individually in the crankcase, each being a complete assembly of roller, hollow adjustable plunger and guide. They are held in in pairs by dog clamps and studs. Timing is as follows:

	Opens	Closes
Exhaust...........	45 deg. early	5 deg. late
Intake.............	12 deg. late	35 deg. late

There are three diameters for the camshaft bearings, $2\frac{1}{4}$, $2\frac{1}{8}$ and 2 in., their lengths being $2\frac{1}{4}$, $1\frac{3}{4}$ and $1\frac{3}{8}$ respectively. On the rear end of the shaft there is a skew gear driving the oil-pump shaft, this being the extreme end, beyond the rear bearing. Thrust from the gears is carried to the front end of the shaft, and resisted by a spring-backed hard-steel plunger which sets in a socket in the front-end cover. The pump shaft is, of course, vertical, and the coupling to the pump itself consists of a short coil spring with the ends bent across the coal diametrically. Both the drive shaft and the pump shaft are slotted and the ends of the two nearly meet, the bent-over extremities of the springs setting in the slots. This allows the oil pan and the pump with it to be removed and replaced with a minimum of trouble.

High Spots in the Standard Truck

1—*Ten experimental engines and two experimental complete trucks are to be built, and makers have already been selected.*

2—*The engine has four $4\frac{3}{4}$ by 6 cylinders, cast in pairs, with detachable heads.*

3—*Much attention has been paid to the cooling and lubrication problems.*

4—*Force-feed lubrication is used throughout and the oil is doubly strained.*

5—*Two entirely separate ignition systems, one battery, the other magneto, are used.*

6—*The crankcase, including the bell housing and the oil pan, is aluminum. Three-point support is used.*

7—*The crankshaft is very rugged, and is notable for its large intermediate bearing, as long as the rear one.*

8—*The governor is the steel-ball type, and so inclosed and sealed that it cannot be tampered with.*

9—*There is a dry disk clutch, a four-speed horizontally arranged change gear, a worm drive, a full floating rear axle and Hotchkiss drive.*

In the front end there are four gears; the crankshaft pinion, pressed on the end of the shaft; the camshaft wheel, driving the generator gear; and, on the other side, the gear for water pump and magneto. The governor motion attaches directly to the front end of the camshaft.

Thus, on the right side of the engine are the generator, the carbureter, and both manifolds, while on the left are the water pump, magneto and battery ignition distributor, the latter being set on top of the front-end case, where it can be driven by skew gear off the water pump drive shaft. This makes for ease in linking together the magneto and the timer advance controls, and keeps all wiring on the one side of the engine.

The governor consists of steel balls held between a disk that can slide forward against a spring, and a female cone fixed to the camshaft front end. In moving forward, the disk bears upon the short end of a vertical lever, the upper end of which is linked to a throttle in the intake manifold just above the carbureter attachment flange. This lever is fully inclosed, and the spring which pushes against the centrifugal action of the balls is set in the case halfway up the lever. Here there is a threaded plunger with a lock nut, by which the pressure on the spring is set, and both pin and lock nut are secured when set by a sealed wire that entirely prevents unauthorized adjustment. The throttle, operated by the governor, is the usual butterfly sort, but the spindle is set a little off center, so that the suction of the engine tends to open it, this making for a quick reopening and preventing sluggish action.

The water pump is a separate assembly, and its shaft is coupled to the drive shaft, which is set in the crankcase and carries the gear. This makes the pump detachable without disturbing the front end. The magneto is set well back on the left side, and is coupled to the rear end of the pump shaft. Clearances are large, and no accessory is placed awkwardly.

Has 130-Lb. Flywheel

The crankshaft is a conventional design, although a counterweighted shaft is to be tried. The diameter is $2\frac{1}{2}$ in. on the three main bearings and $2\frac{3}{8}$ on the pins. The bearing lengths are 4 in. for the rear and middle bearings and 3 1/16 in. for the front, the pins being 3 in. long. The webs are very stiff, the long ones having a section $3\frac{3}{4}$ in. wide by $1\frac{3}{4}$ in. thick at the thickest point, the 7-deg. draw angle subtracting little from the thickness at the edges. The proportions allow perfectly straight holes to be drilled for the oil direct from each main bearing center to the pin centers. For the flywheel attachment there is a flange. (*Continued on page* 518)

Work of the Factory Metallurgist

A Review of the Activities of the Chemical and Metallurgical Departments of Automobile Factories, and Some of the Problems That Confront Them

DETROIT, Sept. 15—The Detroit Section of the S. A. E. opened the fall and winter season last night, when chemical and metallurgical research as applied to the automotive industry was considered. The paper was in the nature of a report of the Chemical and Metallurgical Division of the Industrial Research Committee connected with the Detroit section. R. H. Sherry, metallurgist of the General Motors Co., who is chairman of the committee, read the paper. The other members of the committee are A. E. De Clerq of the Chalmers Motor Co.; K. M. Wise of the Detroit Testing Laboratory, and F. E. McCleary, metallurgist of Dodge Bros.

The paper was in the nature of a text book on metallurgy and chemistry as applied to the automotive industry; it covered a wide range in this field and presented the matter in a way which is readily understood by men who have not devoted years of study to metallurgy. One of the principal objects of the paper was to establish a connection between the designing engineer and the metallurgist, by showing the respective influence of features of design and choice of materials upon the performance which can be expected from any part. It also showed how it is possible to trace failures in parts which have been blamed upon improper materials to faults in design.

The author points out that the work of the metallurgist in the automotive industry is closely connected with the main branches of manufacturing, engineering, experimenting and purchasing. Its own peculiar field, of course, covers specifications, inspecting and testing of material, and scientific control of the treatment of the materials. Of the chemist is required analytical control of the materials entering into the output and also those upon which the factory is dependent for production. These functions have been well covered in publications in various scientific journals. The connection of the laboratory with production has not been so thoroughly covered and it was the purpose of Mr. Sherry's paper to outline this phase of metallurgical work. In doing this it was possible only to touch upon the main points, and instances of faulty conditions were mentioned, not necessarily because of their constant occurrence but because of the serious delays to production which they may cause.

Points Made in Sherry's Paper

1. *A square end milled at the end of a round shaft weakens the shaft. Upsetting the end of the shaft before milling is better.*
2. *One of the fundamental principles of design is the avoidance of nicks and sharp corners in parts under alternating stresses, yet there are few who give this point the proper attention.*
3. *Shafts which have been ground smooth will run under a considerably greater load without fracture than will shafts with tool marks.*
4. *In work to be case-hardened, sharp ends and corners and other designs which permit of penetration of the carbon from two sides so as to meet must be avoided.*
5. *Partial hardening of any case-hardened sections will permit the use of many designs which are otherwise out of the question; copper plating being a simple method, will give good results if handled with care.*
6. *There are many old-time superstitions connected with certain materials which are hard to eradicate. One of these is the bad effect of a few points of sulphur.*
7. *The modulus of elasticity is practically the same for all steels, and in cases where this is a factor in the failure of a part, changing the steel will be of no assistance.*

Squared Shaft Ends

The first step in the manufacture of motor vehicles is the design of the various parts. Here the designer is limited by the selling price of the machine and by the ability of the shop to manufacture the part under circumscribed conditions. This frequently leads to selection of certain standard designs for their simplicity in machining. One design of this kind is the square end milled at the end of a round shaft, a design belonging to the earliest days of manufacture and still used in certain parts. It should be obvious that through this operation the part is weakened and that the extra material over and above the size of the square end is simply wasted. Upsetting the end of the shaft before milling will give more satisfactory results. This operation necessarily leaves more or less sharp corners at these points, and, especially when case-hardened, gradual fracture may occur under alternating stress. Many cases of this kind have been observed and have frequently been thought due to the material, until it was found that even change of material was of no benefit. Some of the reasons for this will be discussed later. In some designs this square end will give perfect satisfaction until the weight of the machine is increased and breakage occurs. The only remedy is to make some change in the design, as, for instance, the substitution of splines for the square end.

Effect of Sharp Corners

One of the fundamental principles of design is the avoidance of nicks and sharp corners in parts under alternating stress, yet there are few who are guiltless under this head. Cases in point may be readily found even at this late day. If there be any doubt on this point, a test can be made with a bar about ½ in. wide and ¼ in. thick, of any steel of about 0.20 per cent carbon. Bend it back and forth in a vise and note the number of bends required for fracture. Take a similar bar ⅜ of an inch thick, nick with a V to ¼ in. and bend. In nearly all cases fracture will occur on slight bending. Even scratches may have a marked effect. Heavy rear axle driveshafts of the semi-floating type have been known to break on account of tool marks. Of course, if the axle is full floating and under no alternating stress, rough tool marks are harmless. Grinding the first type of shaft has generally been found to stop the trouble instantly.

Parts may be designed properly without nicks and sharp corners, only to give way in service through some fault in manufacturing. In one case the machining operations on a pivot axle were changed to permit of easier machining, and an apparently simple and proper method selected. After

cutting the radius at the head, the spindle was machined from the smaller end toward the larger. The surfaces produced did not coincide, the result being that a small nick was left. These parts broke after very short service. Eliminating this nick stopped the trouble.

The effect of nicks has been determined in the alternating stress test and it has been found that shafts which have been ground smooth will run under a considerably greater load without fracture than will shafts with tool marks. In the latter case the critical load will be found decidedly low. If the rough shaft is stressed below the critical load, its life will be indefinite. A slight increase in the load to just beyond the critical stress will result in rapid deterioration.

Co-ordination of Design with Shop Method

These are some of the most prominent points of design in its effect upon wearing quality. Many others might be mentioned. There is another phase of design which deserves mention, and that is the necessity for its co-ordination with the shop methods. The necessity for this is greatest in the case of parts that require hardening. Frequently parts come to the hardening room that are to be partially hardened, but inspection shows that it is practically impossible to carry through the hardening process as demanded. In some cases the design is intended to lower the cost of machining or assembly. An example of this was found in a bolt about ½ in. in diameter. One end was drilled so as to leave a wall a little over 1/16 in. thick. A thread was cut in the outer wall of the drilled end and carbonizing deep enough to permit of grinding was called for. This meant carbonizing practically all the way through and the result may be left to the imagination.

Case Hardening Piston Pins

For case-hardened work especially, sharp ends and corners and other designs which permit of the penetration from two sides to meet must be avoided. The piston pin is a simple part requiring careful design and treatment. It contains sharp corners, spalling off may occur after hardening and a small radius should be used at such points. If drilled before carbonizing the end should be kept as flat as possible or the whole end may spall off in a ring. If the pin hole is too near the end, complete hardening may occur in the section between the hole and the end of the pin. Drilling after the carbonizing operation and before hardening is the simplest method of avoiding trouble of this kind.

Partial Case Hardening

Partial hardening of many case-hardened sections will permit the use of many designs which are otherwise out of the question. Copper plating is a simple method and will give good results if handled with care, the principal factor of success being the removal of surface scale, dirt, and grease. Bevel ring gears should in most cases be copper plated before the finishing cut on the teeth. This leaves the metal in a soft condition so that the gear may be subjected to a straightening process which would be impossible if it was surface-hardened all over.

Where machining operations are required after hardening, copper plating is largely used, but in some cases better and more economical results will be obtained by removing the carbonized layer by a machining operation before hardening. Shop conditions will generally determine the method.

Selection of Material

After the choice of design the next step is the selection of material. The various materials used in motor vehicle construction have been thoroughly examined, and the results of tests have been published, so that this phase will not be extensively covered here. The non-ferrous materials are well classified. Steel is the material of widest range and greatest use, and so must be considered here to a greater degree.

The use of screw stock for its machining qualities is well known, the uses of the various grades of carbon steel require no explanation, and it is well understood that the function of the various alloy steels is to furnish greater strength, permitting of lighter construction or greater hardness.

The selection of steel for purposes of construction requires a knowledge of the physical properties and of the various conditions resulting from heat treatment. The factors which govern the choice of material are suitability and cost. It is waste to use a high-priced alloy steel where a cheaper steel would serve and it is equally a waste to try to economize on parts where the best material is required. Material may frequently be chosen by test, but very often tests cannot approximate all the conditions of service and actual trial of the material in service is then necessary.

Effect of Sulphur

There are many old time superstitions connected with certain materials which are hard to eradicate. One of these is the bad effect of a few points of sulphur. This may be carried to extremes, as in one case where a large number of forgings were scrapped because the analysis of drillings taken from the center showed the sulphur content to be 0.05 per cent. The specifications called for not over 0.045 per cent. Analysis of drillings taken half way between the center and the outside showed 0.035 per cent. The amusing thing was that these forgings were all to be drilled in the center, leaving only a shell.

There are certain types of steel naturally seamy, requiring a rather low sulphur content. At the present time alloy steels high in sulphur are entering the market on a demand for material that is more easily worked. One would not be far from wrong in stating that the mills could not roll steel high enough in sulphur to be seriously harmful in most cases.

Quality of Material vs. Design

Another persistent idea is that trouble in service is generally due to the material and that change in material will stop the difficulty. In some cases this is true, but it is well to make sure that the trouble is not due to some other cause. Many cases of breakage, as has been mentioned, may be due to faulty design and no change in material will help. The modulus of elasticity is practically the same for most steels, and in cases where this is a factor it can be seen that mere change of steel can be of no assistance. This point has been noted time and again in crankshaft construction, where alternating stress is a factor.

Points Made in Sherry's Paper

1. *In certain alloy-steel forgings of high carbon content, surface cracks may occasionally be found along the flash line.*
2. *Cold-drawn bar stock sometimes contains slivers due to the formation of surface seams in the hot rolling.*
3. *Standardization and uniformity of composition and condition are necessary for rapidity of production in the shop as well as to insure proper structural conditions.*
4. *Drilling operations require a comparatively narrow range of hardness for the best results. The operator must not be misled by surface hardness.*
5. *The depth of penetration in the carbonizing process is a function of time and temperature, the effect of the latter being more important.*
6. *Cases have been noted where steel was decarbonized* 0.005 *in. in a few minutes in a dirty lead pot.*
7. *Preheating is required before inserting work in lead pots, in order to prevent freezing of the lead to the cold surface, and also to keep the temperature more uniform.*
8. *In every factory there is a place (usually in a hidden spot) which should be familiar to the metallurgist, and that is the scrap pile.*

In making changes in materials, the shop conditions should be taken into account or trouble in production may result. As an example, consider a shaft made from steel of such a nature that after case-hardening the core remains soft enough to allow the required straightening. A stronger core seems desirable and other material is selected, without reference to shop conditions, in order to produce this result. As soon as the straightening operation is reached it may be found impossible to carry this out without breaking the shaft. Some shafts may appear to straighten properly, only to break in service on account of almost invisible cracks which have developed. In many cases the shafts will be found to break under far lower loads than were used to bend the softer material. Similar cases will occur to the mind of the shop man, but these will serve to illustrate the point that if a radical change in material becomes desirable, manufacturing conditions should be taken into consideration.

Considerations of Cost

If two steels give practically the same result under the same conditions, the cheaper should be brought forward. This does not always mean the cheaper in first cost, for the cost of handling and treatment may be high, a factor which is sometimes overlooked. Standardization and simplification are particularly necessary in the cases of tool steels. The functions of the various tools are well known and it should be possible to develop a few types which are particularly adapted to the work required. These conditions should not serve to obstruct research on improved materials, but should make the object of such research more pointed.

Bar stock for forgings should be carefully inspected for pipes and seams. It is better still, if possible, to look for these faults in the billet, where they will be more apparent.

In certain alloy steel forgings of rather high carbon content surface cracks may occasionally be found along the flash line. In many cases they are so shallow that machining will readily remove them, but at times they may be too deep or be the cause of hardening cracks on quenching from high temperature. Where trouble occurs, a careful inspection of the forgings should be made to insure the absence of such seams.

Cold-drawn bar stock sometimes contains slivers, owing to the formation of surface seams in the hot rolling. If case hardened without machining slivery sections may spall off, spoiling the part. These can usually be detected by inspection of the bars. At times other troubles, usually due to the condition of the surface, may develop, necessitating careful inspection.

Inspection of Sheet Metal

The inspection of sheet metal is an art in itself, on account of the many uses to which it is applied and the many varieties which are made, so that no attempt will be made to cover this in great detail. The manufacture of sheet has improved to a decided extent in the past few years, and a large proportion of the product will be found suitable for the work desired. With cold-rolled sheet for deep drawing the principal trouble has been lack of ductility, due to improper rolling or annealing, or to the presence of a coarse-grained structure in the metal developed by the rolling and annealing treatment. No trouble should occur with sheet that is fine-grained and which has been properly annealed, provided that the metal is not overstrained in the operation. The amount of draw is, of course, limited by the ductility of the metal, of which the reduction of area is a measure. If fracture occurs in a deep-drawing operation a measurement of the reduction of area at the point of fracture will usually enable the cause to be traced. If a high reduction is found, then the metal must be in good condition and the cause may be due to the application of stresses beyond the power of endurance of the metal, or in other words, to too great a draw in the operation. At times fracture may occur in some definite position with high reduction. This may be caused by the use of too sharp corners or edges on the tool, throwing all the strain at this point. Where local fracture occurs frequently with high reduction of the steel, in drawing or rolling sheet metal, examination of the tool should be made to locate any possible faulty design. As large radii as possible should be used.

When composition and condition are of special importance and it is necessary that materials be up to certain specifications inspection becomes more complicated and chemical analysis, physical tests, and metallurgical examination may be necessary. Composition is usually determined by chemical analysis, and on account of certain factors affecting the uniformity of the material special care is required in sampling. Particularly in the case of forgings, care should be taken to get below any decarbonized layer which may occur, especially at the center of the piece. Where millings are taken it is safest to remove the surface metal to a depth of about ⅛ in. Careless sampling may be the cause of considerable uncertainty or of actual trouble. Alloys, particularly bearing metals, are frequently segregated, and it is sometimes necessary to take samples at various points, mix, melt, and cast, taking the final sample from this casting.

Gray iron castings require special care in sampling for analysis, on account of wide variation in section and in casting conditions. Each casting requires individual consideration in order to insure representative sampling. At times it is possible to cast test bars from the melt or coupons attached to the casting which will be satisfactory for sampling, and where the casting is made in large quantity or is valuable and would be destroyed by sampling, this method is decidedly useful. Gray iron castings should be inspected for hard spots, sand holes, pitting and off-centered coring. Variations in the wall thickness of certain castings may cause difficulty in machining the thinner side where the combined carbon will be higher.

Tests for Condition of Metal

To determine the condition of the metal some form of physical test is usually required, or possibly microscopical examination. There are various forms of physical tests, all of which are well known—transverse, tensile, torsion, compression, alternating stress, shock, Brinell and scleroscope, and others of a special nature. For speed and simplicity the Brinell test is one of the most satisfactory, especially when checked by occasional tensile or torsion tests. Certain steels may contain segregated areas of free ferrite, pure iron, and tensile test pieces containing such areas may give lower results than should be expected from the steel. Such segregated areas, although possibly showing up prominently in the test piece, usually have little or no effect upon the actual service of the steel. In cases of this kind, especially in shafting, the Brinell test will usually give more accurate results than can be obtained by the tensile or torsion test. After the proper comparisons have been made between Brinell hardness and tensile or torsional properties, this test may be used for quick and accurate results.

The scleroscope test, although widely used, has a rather limited field, giving its best results with hardened or heat-treated alloy steels. A smooth level surface is required for any degree of accuracy. On heat-treated carbon steels of forging grade the scleroscope test does not usually give satisfactory results, possibly on account of the small space tested or because of inability to meet all the necessary conditions. In many cases decidedly wide variations in results may be obtained even on tests made in close proximity.

Checking Carbonization

In automotive construction two kinds of case are required, light and heavy, the latter usually when grinding is to follow. The proper depth of case for these may be given for most requirements as from 0.020 to 0.030 in. for the light and from 0.040 to 0.050 in. for the heavy case. In rare instances will it be necessary to exceed these limits. Where deeper cases are demanded it will frequently be found that a rearrangement of the design or a more careful regulation of the straightening process will permit of a lighter depth. Often it will be found that far lower depths of case are being used in practice than called for by the blue-print, with no trouble. Case hardened screw stock transmission gears with a depth of case of about 0.008 in. have been found running on cars of ancient vintage having given good service for years with practically no signs of wear. The cost of unnecessary depth of case may run high and the rule should be to carbonize no deeper than necessary. The depth of penetration should be carefully controlled by time and temperature.

The New Chevrolet Eight

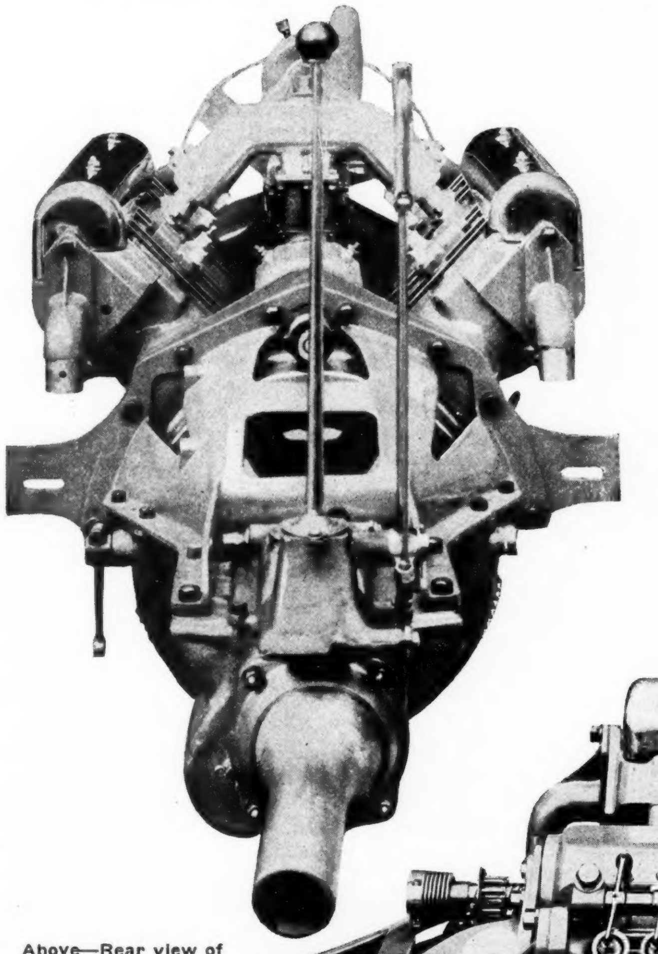
Made Either as a Touring Car or a Chummy Roadster—Both Models to Sell at $1,385—Former Chevrolet Practices Embodied in New Model

WITH the announcement of its new eight-cylinder car, the Chevrolet Motor Co. of Flint, Mich., enters a field somewhat different from that in which it has been operating heretofore. The new Chevrolet is a car very much larger and more powerful than any model turned out under the Chevrolet name in recent years. It has a wheelbase of 120 in. and is equipped with a 3⅜ by 4-in. engine, which gives a piston displacement of 286.3 cu. in. Equipped with either a four or five passenger body, the car sells at $1,385.

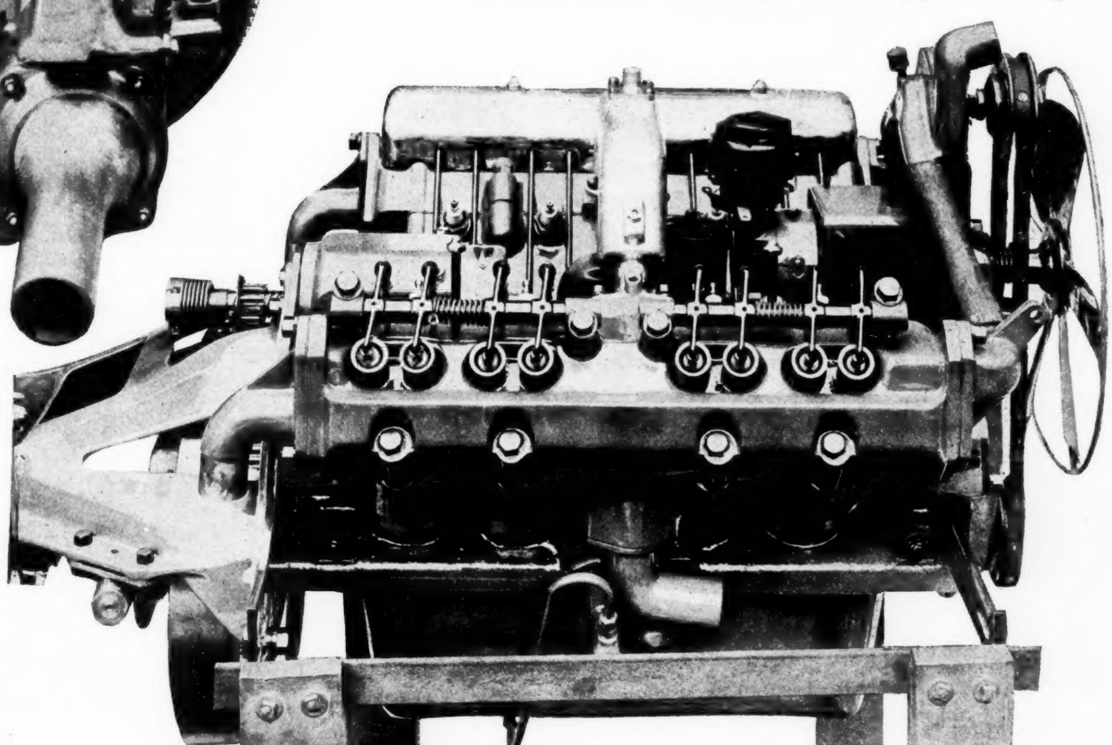
In many respects the engine design follows previous Chevrolet practice. Overhead valves operated by tappet rods and rock levers are used, and lubrication is by splash. The engine is of the high-speed type, running up to 2400 r.p.m. Each set of four cylinders, together with one half of the upper part of the crankcase, is cast in a block, but the cylinder heads of each set of cylinders are separate castings secured to the cylinder blocks by two bolts on the inside of the V and four bolts on the outside; one-half of the crankcase being cast integral with the cylinders, the crankcase is divided in a vertical plane.

The valves have a diameter of 1½ in. and a lift of ¼ in. They are arranged all in a line on top of the cylinder heads. Their rock levers are mounted on rock shafts carried in brackets on the cylinder heads. Between the two rock levers of each cylinder there is a spacer on the shaft, and between the rock levers of adjacent cylinders, a coiled spring is placed, the object being to take up all slack and obviate rattling. The valve mechanism on top of the cylinders is inclosed by a pressed steel housing which is held in position by means of two studs and nuts. A single camshaft, directly above the crankshaft, operates all valves; it is mounted in three bearings.

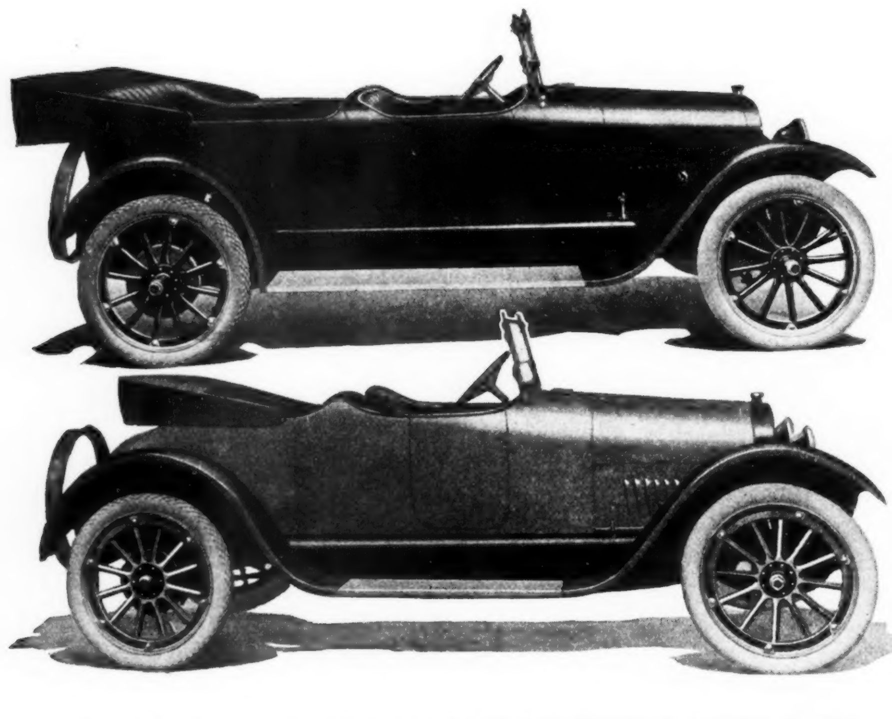
The pistons are conventional design, gray iron castings and provided with compression rings at the upper end. The connecting-rods are drop forged of carbon steel and heat treated. They are provided with bronze bushings at the small end and with bronze-backed babbitt bushings at the big end.



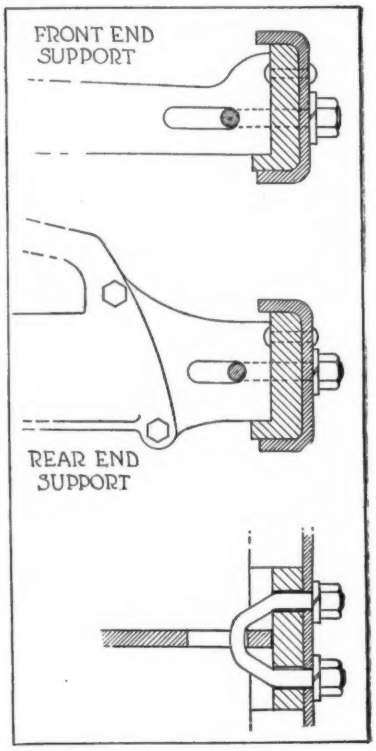
Above—Rear view of power plant, showing form of transmission support



Right—Side view of engine, showing valve mechanism and arrangement of accessories



Above—Five-passenger touring car. Below—Four-passenger chummy roadster

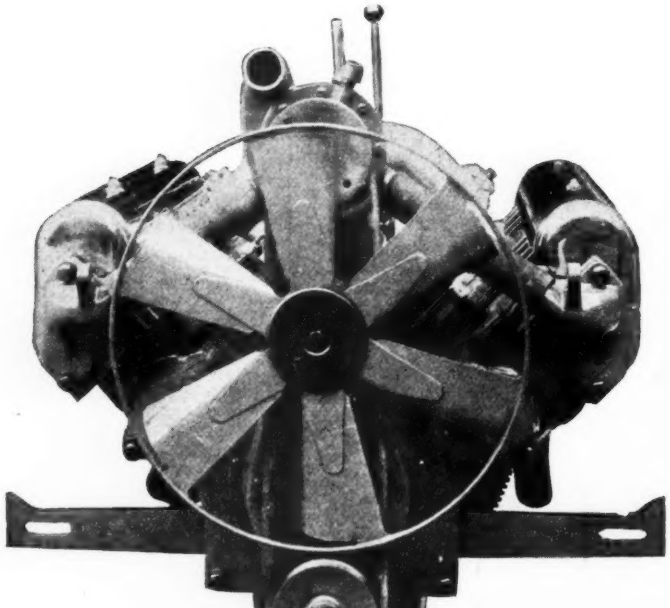


Sketch of engine support

Connecting-rods of oppositely located cylinders are mounted on the crank pins side by side, the two-cylinder blocks being staggered.

The crankshaft has three main bearings, the front bearing being 1¾ by 3 3/16 in. long, the center bearing 1 31/32 by 2 and the rear bearing 2 by 3 7/16. The connecting-rod bearings are 1 7/16 in. in diameter by 1½ in. long. The main bearings are of the same type as the connecting-rod big end bearings.

The lubricating system is of the circulating splash type. The oil is circulated by a plunger pump on the right side of the engine. The plunger of this pump extends through the crankcase and is operated by an eccentric on the camshaft. The pump forces the oil through a distributer pipe inside the crankcase with outlets to individual troughs. Under the connecting-rod heads, a branch lead from the pump is carried up to the instrument board, where it connects to an oil pressure gage.



Front view of engine, showing supporting member, water pump, fan drive, etc.

An interesting method is used for lubricating the valve mechanism on top of the cylinders. The inclosure of this mechanism is not oil tight, hence it is impossible to operate it in an oil bath, yet it is essential that it be furnished with a constant supply of lubricant. This is accomplished by means of an oil pad soaked full of oil which is placed over the rock levers and held in place by the valve cover.

Gasoline is carried in a rear tank of 20 gal. capacity which is provided with a gasoline gage. Gasoline feed is affected by a Stewart vacuum system. A double Zenith carbureter is used, comprising a single float chamber with individual jets and venturis for each set of cylinders. The intake pipe, which is in the form of a T, is water-jacketed aluminum. Hot air is taken into the carbureter through an air heating stove around the exhaust pipe of the right hand set of cylinders. Both the inlet manifold and the exhaust manifold are cast in the cylinder heads, so there is only one inlet connection and one exhaust connection to each of the cylinder sets, the former being at the middle of the cylinder head at the inside and the latter at the rear end on the outside.

Battery ignition is used, the ignition system comprising a Remy combined timer and distributer which is mounted on the rear end of the generator and driven by a vertical shaft. The coil is placed on top of the generator and the spark plugs are located in the cylinder wall on the inside of the V.

The starting and lighting system is of the two unit type and of Auto-Lite make. Both the generator and the starter are located in the V of the engine, the former at a forward and the latter at the rear end. The generator is driven off the camshaft gear, and it has the radiator fan mounted upon an extension of the armature shaft. Thus the fan is driven through positive gearing, but it is held on its shaft by means of a friction clutch which will allow it to slip slightly in case of sudden changes in engine speed. The starter drives through a Bendix drive. A six-volt 120-ampere-hour Willard storage battery is carried. The equipment of lights comprises two 16-candlepower headlights with 4-candlepower dimmer bulbs, a 2-candlepower tail light and an instrument board light.

The cooling water is positively circulated by a centrifugal pump. Contrary to conventional practice, this pump is located in the line between the jacket outlet and the radiator. The reason for thus placing the pump was to make it as accessible as possible and at the same time facilitate the drive. The pump is driven from the engine crankshaft by a trapezoidal belt. There is a double inlet to the pump, one from each cylinder block, and a single outlet to the top tank of the radiator. From the lower tank of the radiator there are hose connections to each of the cylinder blocks. The radiator is of the hexagonal cellular type and has a separate drawn steel housing. Its filler cap is covered with a hard rubber composition.

The engine is supported on the main frame by means of a three point support. The supporting means are quite unusual and are a development of the design used on the four-cylinder Chevrolet. Two steel pressings are used, which extend all the way across the frame and are fastened to the side members. The one at the rear is placed between the rear face of the crankcase and the transmission support, being held in place by the same bolts that fasten the transmission support to the crankcase. The front supporting member is not rigidly connected to the crankcase but has a swivel connection at the middle. The ends of both supports are connected to the frame side members in the same way. A casting is set into the channel of the frame member and secured to it by rivets. The inner face of this casting is machined off, and a ledge is formed at the lower end, on which the engine support rests. It is held against endwise motion by means of dowel pins in the casting and is secured to the frame by means of U bolts passing through slots punched in the support and through holes in the casting and the frame, and nuts are screwed over the ends of the U bolts outside the frame and locked by means of spring washers.

Leather-Faced Cone Clutch

The clutch is of the leather-faced cone type and is provided with 10 auxiliary springs under the leather. A feature of the clutch assembly is a self-lubricating clutch collar. The transmission is of the three-speed selective type and is operated by a central control lever, which is of the ball-mounted, ball-ended type. The transmission casing, which is of cast iron, is supported from the engine crankcase through the intermediary of the so-called transmission support. This extends about half way around the flywheel, but has a number of openings in it to permit access to the clutch and for the sake of lightness. From flanges on this transmission support depend brackets for supporting the clutch and brake shafts. All bearings in the gearcase are New Departure.

On the right side of the transmission is an air pump which is driven through spur gearing from the clutch shaft. Operation of the air pump is controlled by a foot button extending through the floor.

Transmission to the rear axle is by an inclosed shaft with two universal joints. This feature is somewhat unusual, as the ordinary practice where two universals are used is to have the propeller shaft exposed. To make it possible to inclose the shaft, each of the two universals is surrounded by a spherical joint which is filled with grease for the lubrication of the universal. The final drive is through helical bevel gears, the reduction ratio being 4¼ to 1. The rear axle is the built-up type, comprising a malleable central housing and steel tubes, together with malleable brake supports at the ends. All of the bearings in the rear axle assembly are the Hyatt flexible roller type, except for the thrust bearings, which are ball-bearings. The rear axle is semi-floating, the driving wheels being keyed to the ends of the vanadium steel axle shafts. Since there are two universal joints in the propeller shaft, neither the driving thrust nor the torque reaction can be taken on the propeller shaft housing. Torque reaction is taken up on a tubular, triangular torque member and the driving thrust is taken in the rear springs.

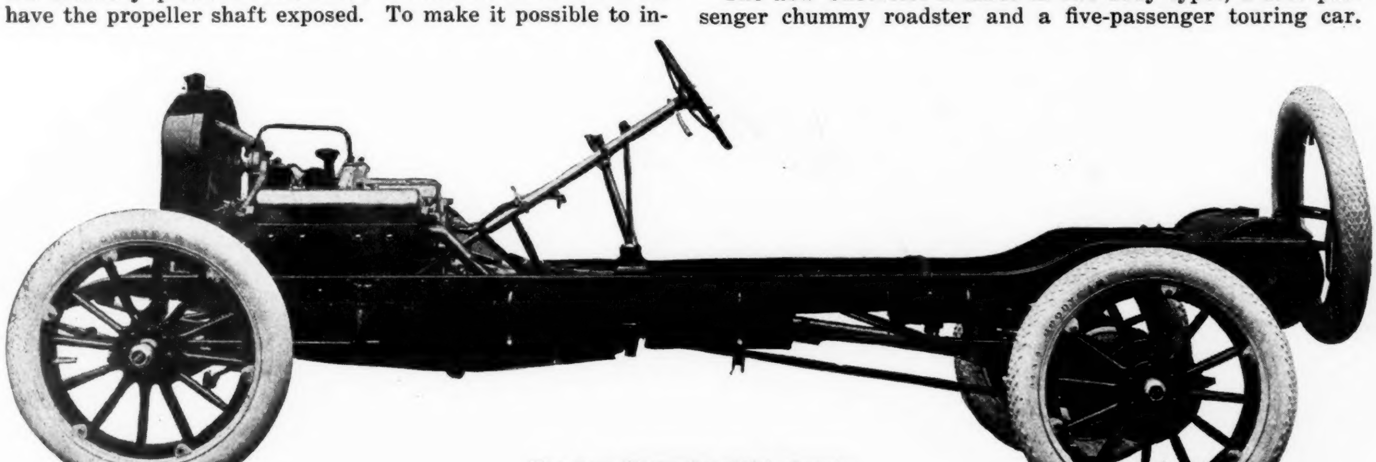
Worm-Wheel Steering Gear

There is nothing out of the ordinary in the front axle and steering gear construction. The former is the usual I-section with forked steering heads, and the steering gear is the worm wheel type. Steering is effected by means of a 17-in. corrugated mahogany wheel, and the steering column is braced by a bracket secured to the instrument board. At the floor board the steering column passes through an aluminum floor board cover, in which there are slots for the brake and clutch pedals. The tie rod of the steering mechanism is located back of the axle. Spark and throttle control levers are located on top of the steering wheel, their shafts passing through the hollow steering post and carrying at their lower ends short levers from which there is link connection to a transverse control shaft back of the radiator. From this control shaft connection is made to the ignition timer and the carbureter throttle. All joints in the control linkage are of the ball type.

Both sets of brakes act directly on rear wheel drums 12 by 1¾ in. The internal brakes, which are cam operated, are the service brakes, and the external brakes, which are operated by means of the usual floating lever mechanism, are the emergency brakes. The brake operating shafts extend forward of the rear axle about half way to the propeller shaft, where they are supported in brackets on the axle housing. There is an intermediate brake shaft about midway between the brake pedal and the rear axle.

The pressed steel frame channels are straight, except for a kick-up over the rear axle. They have a section of 4½ by 1¾ by 5/32 in. At the forward end the frame is supported by the usual half elliptic springs, but at the rear end quarter elliptic cantilever springs are used which are secured by clips and bolts to pads on the axle housing and brackets on the frame respectively. These springs take the driving thrust. Where the rear springs fasten to the frame, the latter is provided with a cross member which is secured to the side members by very large gusset plates. The wheels are the standard wood artillery type and are fitted with 34 by 4 Goodyear tires on demountable rims.

The new Chevrolet is made in two body types, a four-passenger chummy roadster and a five-passenger touring car.



The new Chevrolet eight chassis

French Transport Service Highly Organized

Part I

Care Taken To Keep Trucks Always Busy—Vehicles of All Kinds Handled in Groups—Three Main Divisions Care for Transport of Materials, Food and Men

By W. F. Bradley
Special representative of THE AUTOMOBILE AND AUTOMOTIVE INDUSTRIES *with the Allied Armies*

THE automobile service of the French army is a vast organization equipped for every conceivable kind of haulage and at the disposal of every branch of the army. The variety of work done by ordinary army trucks is greater than that undertaken by any civilian haulage contractor, for the underlying principle is that the trucks shall be at the disposal of the entire army; while one branch may be inactive and have no need for mechanical haulage, another may be passing through a period of intense activity. Thus, for the truck service there are no periods of complete rest such as are known by the infantry, cavalry, artillery and the various technical branches of the army. Truck efficiency demands that vehicles shall be run as constantly as possible, and this condition is obtained by non-specialization: the whole of the automobile fleet being at the disposal of the whole of the army and for the varying needs of that army.

Transport Requirements Alternate

To give specific instances, when an army is consolidating its positions, with no intention of attacking for a considerable time, the amount of ammunition to be carried to the front is reduced to a minimum; but at such a time the amount of material required for new gun emplacements, new trenches, shelters, bridges, etc., is at its maximum, and trucks are kept busy on this class of work. When a big attack is imminent consolidating operations are practically suspended, but at such a time the number of men in the trenches and held in reserve immediately behind the front line positions is at its maximum; thus the trucks which a few days before were carrying building material are all employed on the transportation of men, the supply of food and water for the men at the front, and also the increase of the quantity of reserve ammunition in the "dumps" behind the batteries.

In the French army the artillery is independent of the general automobile service for the transportation of its material. This condition is not common to all the armies of Europe, and even at the present time there is a certain amount of discussion in technical circles as to the value or otherwise of the French system. It is only for the haulage of heavy artillery that automobiles are used to the exclusion of horses. The light 75 mm. field piece presents a special problem: it must possess extreme mobility and be capable of getting into any position. The best results have been obtained by mounting the gun on a special automobile chassis, having nothing in common with the truck chassis and firing it from this chassis. The largest gun carried permanently on and fired from an automobile chassis is one of 102 mm., used by a certain Allied power.

With these exceptions artillery is always hauled instead of being carried, and this necessitates a special type of tractor which in the French army drives through all four wheels. The automobile hauled batteries keep these tractors exclusively for their own use, and also have a certain number of trucks for carrying ammunition from the dumps to the guns. Thus the batteries are entirely independent of the general automobile service for their movements, although they still have to rely on the ordinary trucks for the carriage of their ammunition from railhead to dump. Under this system, when a battery receives orders to advance or retreat it can get under way as quickly as the guns and caissons can be hitched up to the tractors; there is no need to communicate with an outside service or to wait for trucks or tractors to be sent up. The main objection brought against this system is that the tractors are not employed to anything like their full efficiency. If a gun takes up a position and retains it for a month the tractor remains idle for that length of time only a few yards from its gun, hidden under the cut branches of trees or by other covering so as to screen it from the eyes of aerial and terrestrial observers. As to which is the better system depends to a large extent on the nature of the front. In the mountains a big gun can be screened with comparative ease; in the plains there are lesser opportunities for hiding; every gun has a number of emplacements and changes its position at frequent intervals. The problem is one for military authorities only; for the automobilist it is sufficient to note that the artillery service calls for less physical effort on the part of the men than is required in the general automobile service. A highly placed officer in the automobile service who had been trained as an artillery officer and had served at the front with the guns declared that the physical effort required of the men in the general automobile service is ten times that of men in the heavy artillery. Automobile drivers in the general service frequently work sixteen hours a day for considerable periods, while in times of military activity three consecutive days without rest are not uncommon.

Specialization in Transport Equipment

While the underlying principle is that the greatest number of trucks shall be available for the greatest variety of work, it is obvious that there must be a certain amount of specialization. In addition to the artillery the aviation service has its own vehicles and is inde-

pendent of the general automobile service of the army. Incidentally it may be mentioned that no animal traction is provided for in the aviation service, all the material and sheds being transported on special trucks. The telegraphists and observation balloon corps (these latter being a part of the artillery) have their own automobiles; "tanks" are also a part of the artillery, and as such independent of the general automobile service. It is obvious, too, that such vehicles as gasoline locomotives running on rails, road rollers, water sprinklers, tank wagons, etc., are too specialized to be used for anything but the work for which they were primarily designed.

In the general automobile service there are three classes of trucks, which in order of importance are Transport of Material (usually known under the abbreviation T. M.), Transport of Personnel (T. P.) and fresh meat wagons (R. V. F.). The T. M. trucks form the backbone of the automobile service of the army. They are 3½ and 5-ton trucks officially designated for the transportation of material, but in reality employed for every conceivable kind of work in connection with the army and at the disposal of every branch of the army which may happen to require their services. For these trucks there is no slack time, no waiting for events, no material which cannot be carried.

If a quick movement of troops has to be made the T. M. trucks come to the aid of the special vehicles for carrying men; if the artillery is unusually active the T. M. trucks carry shells from the rail head to the dumps or the batteries; if there is a big demand for timber the T. M. trucks go to the aid of the forest gangs; the call is the same if there are big bridge building, road repairing or trench making operations. The T. M. service is the general haulage contractor of the army.

It is difficult to state with any degree of accuracy the proportion of automobiles to fighting men. The following, however, will give an idea. The Xth Army, which on a fair estimate comprises 300,000 men, has an automobile service of 6000 men and 150 officers. As there are always two men to a truck, this gives a ratio of one automobile truck to 100 fighting men. This calculation, however, only takes account of the general automobile service comprising T. M. and T. P. trucks, meat wagons and ambulances. It is necessary to add all officers' cars, the artillery tractors and automobiles, the airplane service and the various specialized vehicles already mentioned. On this basis there is one automobile for forty men in the field. In this connection consideration has been taken only of troops and automobiles in the field; the immense services in the interior, carrying on work which makes it possible to maintain the fighting forces, all have their own automobile services.

Pre-War Development

When war broke out, the only properly organized and really efficient section of the automobile service of the army was that dealing with the transportation of fresh meat. This had been developed during the annual army maneuvers, and automatically went into service with the mobilization order. Where it is now considered necessary to have a fleet of 600 to 700 automobile trucks for service with one division, the whole of the transport service in those early days was dependent on not more than 200 horse wagons. In consequence, the automobile meat trucks carried every conceivable kind of load. In the words of one officer who went into service on the first day of the war:

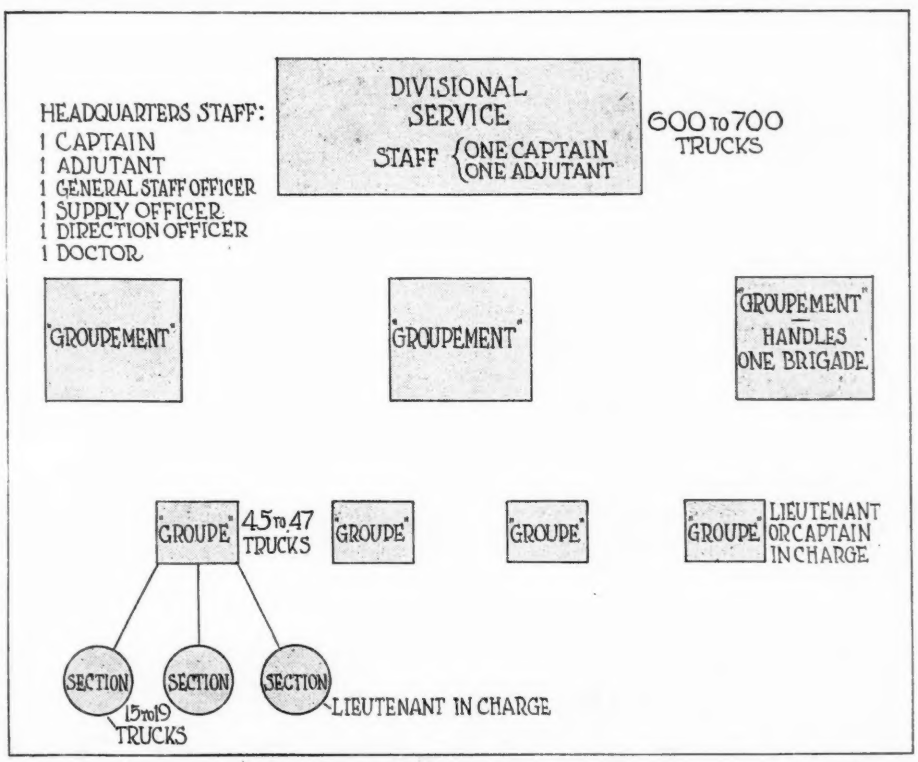
"We went out with fresh meat and we came back with human meat. We took ammunition, timber, barbed wire, blankets, medical stores, reserve troops, then went back for more quarters of beef after washing the bus out—if we could find water or had time to use it."

Army T. M. trucks are formed into sections which originally comprised 20 vehicles. The number of trucks in a section has undergone variation, and at the present time it is fifteen trucks of 5-ton capacity and nineteen trucks of 3½-ton capacity. The basis appears to be that one section shall be able to supply and transport one company, say 200 men. It should be clearly understood, however, that no company has a proprietary claim on any section, nor has any battalion, regiment, brigade or division any right to monopolize the services of any special vehicles. The fighting troops may go into rest quarters; the automobile service continues at work. Each section is commanded by a lieutenant, who has at his disposal a touring car and driver, as well as a motorcyclist. The lieutenant is responsible for the effective working of this section, whether it be operating as a whole, or, as is often the case, split up into subsections of five vehicles; for this work a touring car is indispensable.

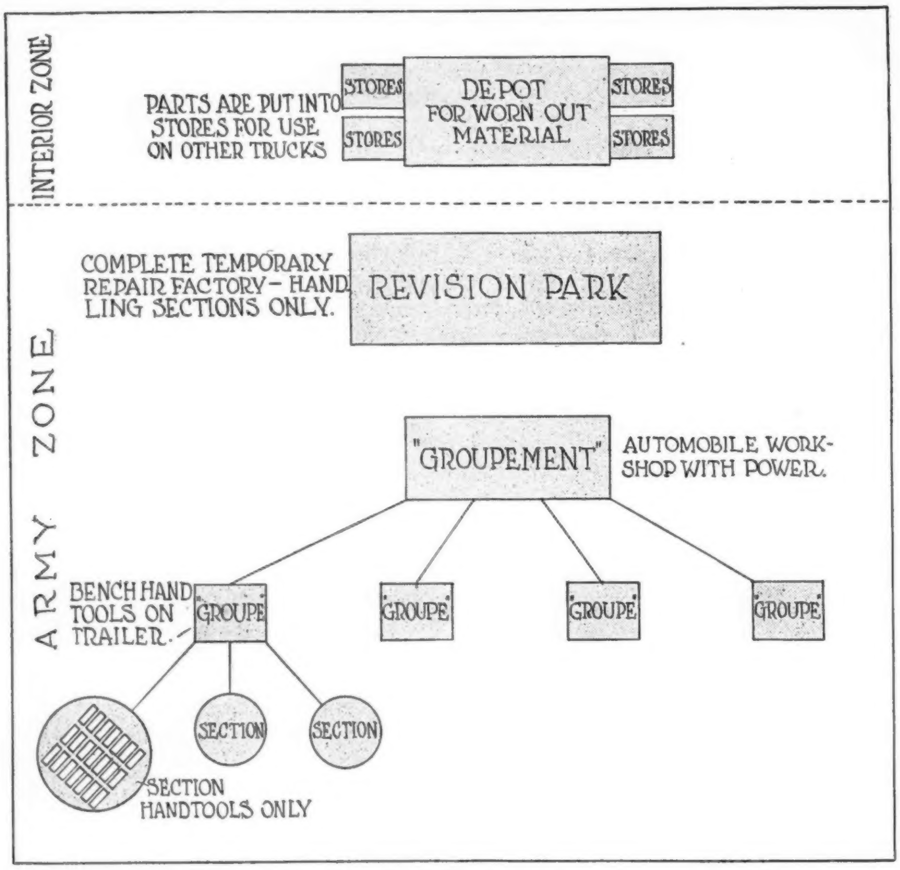
Organization of Transport Sections

On an average there are forty to fifty men in a section, these comprising two drivers per truck, a couple of mechanics for the section and a couple of cooks. The repair facilities at the disposal of a section are limited to a bench, vise and kit of hand tools. Spare parts are nuts, bolts, washers, spark plugs, packing, etc., or only such parts as are common to all makes of trucks. There are no valuable spares on a section.

On one portion of the French front I came in contact with three sections of Pierce-Arrow 5-ton trucks, which



Grouping of automobile service department of the Army Division. This division is for supplies only, no artillery



Repair organization of the Army Division, showing grouping and departments in relation to each other

at that particular time were being held in reserve. They were on a road with no outlet, but in accordance with the general rule were lined up on the sidewalk, sheltered by the trees from enemy observation, and also leaving the full width of the road free for traffic. Each truck had attached to it a two-wheel trailer, which appeared to have been originally designed to increase the carrying capacity of the truck when removing troops. In practice, however, the trailers were made use of as workshop, cookhouse, stores, and in a few cases sleeping quarters. The whole of this district had been fought over and left in a wrecked condition, so that the convoys in addition to carrying a useful load had to bring with them all the material necessary for housing the men. When, as in this case, no permanent buildings could be secured the sleeping accommodation of the men consisted of light tents. These, together with the trailers, formed a permanent base from which the convoy operated, yet the whole of the material could be packed up and moved, together with a useful load aboard the trucks, within one hour of notice.

Greatest Strain in War of Movement

The greatest strain is put on a convoy in a war of movements, for then the maximum amount of transportation has to be undertaken and camp has to be changed at very frequent intervals. Permanently established, the cook can fix up a commodious kitchen and prepare meals under very satisfactory conditions; but when on the move or liable to be called upon to move at a moment's notice all cooking has to be done within a two-wheel trailer under conditions which obviously are not ideal. With their native ingenuity automobile convoy men left in one emplacement for a few weeks at a time can get together a camp not at all lacking in home comforts and without any monetary expenditure. Whatever is of an untransportable nature or interferes with the normal work of the convoy has to be left behind when quick movements are ordered; then the men are entirely dependent on what can be carried with the convoy.

Use of Trailers

The use of trailers merely as an auxiliary for the convenience of the men, without any idea of increasing the load-carrying capacity of the unit, is particularly good. The men in the automobile section of the army have their own co-operative society, with headquarters in Paris, from which they can obtain extra supplies and delicacies at prices calculated to make civilians envious. These three sections of Pierce-Arrow trucks had one covered trailer equipped as a small grocery store. The soldier in charge of this vehicle received his supplies from the central stores in Paris and retailed them to the men of his sections at cost price. If the order came to move, it was only necessary to close the doors, hitch up to a truck, and knock the props away from under the trailer. The repair department for a section is handled in the same way, the two mechanics in charge having a trailer within which all tools and supplies are kept in racks or pigeonholes. Simple work can be done without cover, but usually a rough shed or tent is erected by the side of the trailer so as to give additional room.

The unit in the automobile truck service is a section which, as already stated, may comprise from fifteen to nineteen trucks, according to their tonnage, plus in certain cases a trailer for each or some of the vehicles, plus one touring car and one motorcycle. Three sections form a group, which may comprise from forty-five to fifty-seven trucks, plus, of course, the touring cars and motorcycles for the individual sections. A traveling workshop is attached to each group. It is mounted on a trailer, and is capable of doing all the running repairs of the group, but is not provided with power. Four groups form a groupment which will unite together with officers' cars and motorcycles from 204 to 258 vehicles. The groupment has a very complete repair outfit, with power, capable of doing complete overhauls, and in addition has attached to it seven or eight service trucks and touring cars for the staff officers. An automobile groupment is an absolutely self-contained and self-supporting mobile organization. It carries a very complete supply of spare parts, is in touch with the permanent stores at the rear for the maintenance of its stock; there is practically no limit to the repair work it can undertake, while it is capable of following up and keeping in touch with the different groups and sections dependent on it, when movements are ordered. A groupment is capable of handling the transport of a full brigade. Its headquarters staff consists of a Captain in command, an Adjutant, an officer detached from the Army Headquarters, a Supply Officer, a Direction Officer, and a Doctor. From the administrative standpoint three (sometimes four) groupments constitute a general reserve with headquarters staff consisting of a Captain and an Adjutant. Incidentally American volunteers are now manning at least one such General Reserve and are thus responsible for the transportation of three brigades.

In deciding on spare parts and tools for trucks, American manufacturers and authorities appear to have been too much influenced by touring car practice, and to have assumed, consciously or unconsciously, that their vehicles would operate singly. Thus some American trucks are sent into France with spare valves and springs, fan belts, magneto parts, rubber hose, gaskets, spare main bearings, bolts, nuts and washers, etc.; some of the specifications which have appeared in print provide for an even more elaborate stock of spares, though it is absolutely unnecessary under war conditions.

Prior to 1914 there was a somewhat similar luxury of spares in the French army. Since then the automobile service has learned much, and one of the first actions is to strip American trucks of all the spares supplied by the factory and to order trucks from their own factories without any accessories. The unit in the field is not a single truck but a section comprising fifteen or twenty vehicles, according to their individual capacity. An army trained automobile driver is not given credit for any real mechanical knowledge, and is assumed to be incapable of making use of spares even when they are necessary. In the majority of cases this assumption is correct; the exceptions are beneficial to the service, but they are so rare that they need not be taken into consideration. Compared with the early days of the war automobile organization in France is so highly developed that it would be as absurd to give a big stock of spares to individual drivers as to place them in the hands of men at the wheel of Fifth Avenue buses.

Spare Parts and Tools Carried

One of the best American trucks, and one with the best supply of spares and tools, was noticed on the French front with reserve valves and springs carefully packed in a special spare parts box. For some reason or other these valves had been allowed to remain in the possession of the driver, but the officer in charge stated that this particular truck never burned out a valve, and the spares were absolutely useless. Another American truck with poorly designed water jackets had a rather high consumption of valves, while cracked jackets were not unknown. Yet this maker did not consider a pair of valves a necessary part of his truck equipment. Obviously, the decision as to what is and what is not necessary should not rest with the manufacturer.

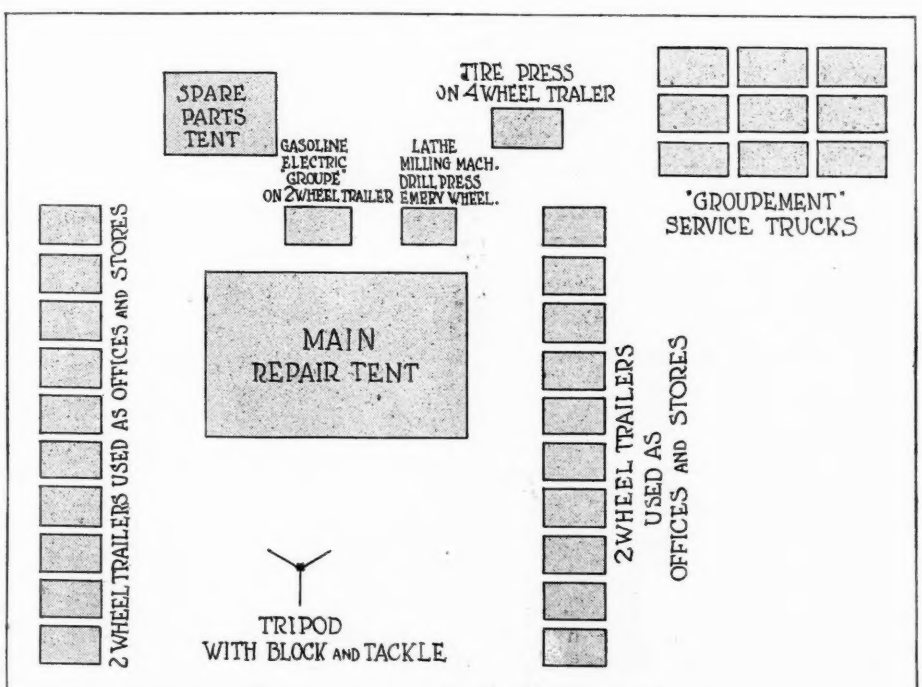
The individual French army truck carries a kit of tools comprising wrenches to fit every nut, hammer, files, grease gun, oil can, jack, a few bolts and nuts, a couple of spark plugs, and, of course, a reserve supply of grease and oil. The tools are uniform for each make or type, and in order to facilitate control are carried on a special tool rack or board, so that the officer can tell at a glance if any article is missing.

Each section of fifteen to twenty trucks has a breakdown tool kit in charge of a couple of mechanics, who are not usually called upon to drive. In some cases the mechanics have at their disposal a two-wheel canvas-covered trailer which serves as a storehouse, but can be used to a limited extent as a workshop. The trailer idea is excellent, for even in a war of movements every section must have some base from which it operates, and the mileage of the trailer is only a fraction of that of the trucks.

Only hand tools are given out to the mechanics responsible for the maintenance of a section. These comprise a vise, bench drill and breast drills, taps and dies, brazing lamp, and, of course, wrenches, hammers, files, punches, etc. In the French army, spare parts are divided into two categories: special and general. The former cover parts which are special to any one make, connecting-rods, for instance. General spares are bolts, nuts, washers, fan belts, spark plugs, gaskets, etc. The section mechanics have a pretty complete stock of general spares, but very few specials. Section mechanics are expected to do all running repairs, but not to undertake anything of a really elaborate nature; they do not have to take down engines, but will decarbonize cylinders and change connecting-rod bearings. It is because the extent of their work is limited that they are not allowed to keep more than a limited selection of spares; they are, however, in a position to obtain parts required at very short notice.

The next stage in the line of repairs is a traveling workshop attached to each group of three sections or forty-five to sixty trucks. While the section may have nothing more than a good kit of tools carried on one of the trucks, the group repair shop is always mounted on a trailer; frequently there are two trailers, one carrying bench and tools, and the other being fitted up with general spares. No power-driven tools are available, but a fairly extensive range of repair work can be undertaken, without however attempting anything like a general overhaul. Section mechanics are interested in keeping trucks on the road; group mechanics take individual trucks at intervals of six weeks or two months, according to circumstances, examine them carefully and carry out repairs and minor replacements.

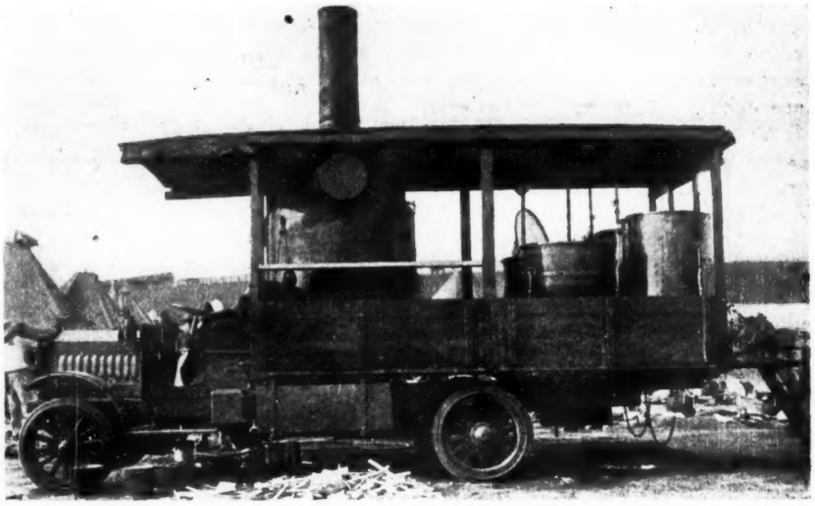
Back of the group is the groupment repair department. This is the last and most important mobile repair outfit in the field. It has to care for four groups of three sections each, being a total of 180 to 240 trucks, together with all the officers' cars and motorcycles attached to the sections and groups, and its own service trucks and officers' cars, making a total not far short of 300 vehicles. (*To be continued*)



Repair unit grouping. This is the largest mobile repair organization in the field

New Type Steam Army Camp Kitchen

Mobile Unit Will Serve Three Hot Meals a Day to 2000 Men



When the kitchen is moved the flareboards are turned up and the stack removed

NEW HAVEN, Sept. 15.—A new type of mobile army camp kitchen, which will serve three hot meals a day to a batallion of 2000 men and will provide enough coffee for 1000 men every 10 minutes, was demonstrated last night on Yale field. Seventeen hundred and fifty men of the 102d Regiment of Infantry were fed in less than an hour.

This is probably the first successful steam cooking unit on wheels, and by its use two cooks displace twenty company kitchen units, which require eighty men and forty horses for operation.

The kitchen is the invention of J. C. La Vin, manager of the Hotel Taft. Associated with him in the perfection of the unit were C. M. Bradford of the Bradford Auto Sales Co., Locomobile and Paige distributer, and H. D. Baldwin of D. W. Baldwin & Sons, body builders. The unit has been styled Taft Army Field Kitchen.

The complete kitchen consists of a 10-hp. steam boiler, two 90-gal. stew, soup, or potroast kettles, and two 50-gal. coffee urns. The boiler is a vertical, fire-tube type and burns coal, wood or oil. Yesterday it burned wood.

The kettles and urns are a special steam-jacketed type designed for quick boiling. They will raise water from 62 Fahr. to 212 in six minutes. Generally, however, water at about 190 deg. is fed into them from the Penberthy injector which feeds the boiler, thereby materially reducing the time required for boiling.

Yesterday, with one coffee urn empty, 50 gal. of excellent coffee were ready in 9 minutes by stop-watch.

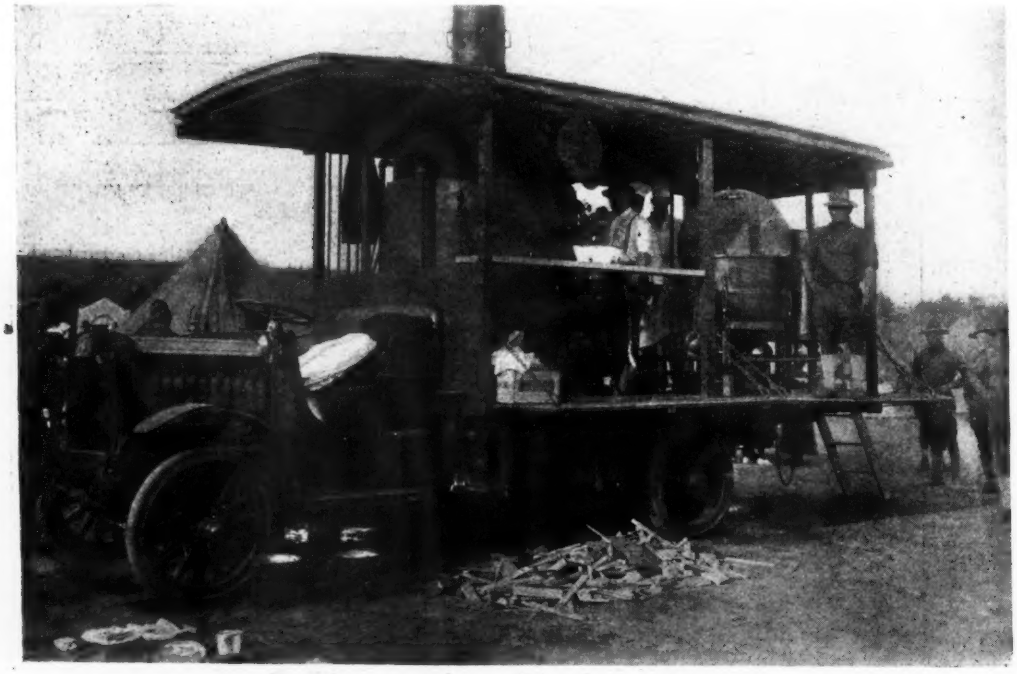
The steam pressure varies from 40 to 50 lb. In addition to being used for cooking, it can also be used for sterilizing mess tins; and it would be a simple matter to use a small part of the live steam for sterilizing surgical dressings and instruments.

The whole cooking unit is mounted on a standard 4-ton Riker chassis. What body there is, consisting merely of a roof and flareboards, which drop down to serve as platform, is light The entire unit probably weighs between 8 and 9 tons. It is capable of a road speed of 15 m.p.h. under favorable conditions.

The unit is designed to go with, or ahead of, a batallion on the march. Meals are cooked on the road and when the batallion halts hot food is ready. When a battallion entrains, the kitchen is put on a flat car and goes right on cooking.

It is planned to add a six K.W. generator to be operated by the truck engine. This would furnish current for officers' tents, for a searchlight and to operate field wireless apparatus.

Last night the boys of the 102d had a royal feed. The food was provided by the Hotel Taft and its cooking personally supervised by the hotel's chef. Here's what they had: Beef bouillon, boiled beef, army beans and coffee. And it was served piping hot.



The Taft army camp kitchen has kettles heated by live steam and can serve hot coffee to 1000 men every 10 minutes

Publications Received

THE WALKER M. LEVETT CO., New York, has issued a booklet on Magnalite Piston Design, by Joseph Leopold, chief engineer of the company. Mr. Leopold goes at some length into the mathematics of aluminum trunk piston design.

We are in receipt of a copy of the new catalog of Peter Frasse & Co., Inc., New York. This new catalog contains a complete description of the various grades and finishes of Frasse electric tool and alloy construction steels. It also has incorporated in it numerous tables which should prove of interest to steel users.

General Electric Co. Creates Skilled Labor

Apprentice School Remedies Dearth of Mechanics—Dispensary, Clubrooms, Athletics, Bonus System, Restaurants and Pensions Make Working Conditions Attractive

SKILLED mechanics are being created by the General Electric Co., West Lynn, Mass. The apprentice school at this plant of the G. E. system is the striking feature of a remarkably complete plant for making factory conditions attractive for the worker. The school is not an immediate cure-all for the shortage of the labor market. The company will lose valuable men to the army, moreover it has consistently encouraged its men to enlist; but the apprentice school does build for the future. It is a case of long run business policy, for it takes 4 years to make a skilled workman out of a grammar school graduate, 3 years out of a high school alumnus, and 2 years out of a college man.

The work of the personnel or labor department is but half done when it has created the efficient employee. It must next make the factory conditions sufficiently attractive to retain the best workers in the face of a competitive market. The largeness of this task is not fully realized, until one grasps the immensity of the General Electric plant at West Lynn. Although in itself but part of a system, it is the biggest factory in the world given over to the manufacture of small motors. The company makes all its Genemotor starting and lighting systems at the West Lynn plant, and the majority of the electric automobile motors used by the General Vehicle company are also made here.

The factory buildings have a total floorspace of 1,500,000 sq. ft. A person starting to walk over the West Lynn factory at 6 a. m., traveling at the rate of 3 m.p.h. without any stops would not have walked through the aisles of every floor by 6 p. m. The working force varies from 14,000 to 16,000 hands comprising the majority of the nationalities of the world. About one-quarter of the employees are women.

An organization of this size, a small city in itself, requires of its personnel department much more extensive duties than the usual factory may demand. The General Electric plant, therefore, has provided a dispensary, two clubhouses, four restaurants, a bonus system, a mutual death benefit association, and pensions. Each of these features is a matter of sound business policy. The dispensary helps to do away with many unnecessary accidents, remedies slight injuries which might otherwise be serious, and above all, prevents the physically unfit from ever entering the employ of the company. The other features mentioned make working conditions pleasanter which always results in increased efficiency and a reduction of labor turnover.

Interior of the Thomson Club for university men. The General Electric Co. employs a number of college and technical school graduates and makes special inducements for them to remain with the company. This building is fitted up after the manner of a fraternity house with mission furniture, open fireplaces, and simple wall decorations

500 in Apprentice School

Possibly the biggest work of G. E. labor department is the apprentice school because this is not only a feeder of efficient workmen to the company, but it also gives the ambitious employee a chance to push himself ahead. About 500 boys are continuously taking advantage of this opportunity and being graduated from the school into higher positions in the company.

Four courses in the school are open to grammar school graduates. These are to train machinists, tool and die makers; pattern makers; molders; and brass molders. High school graduates may be trained to be draftsmen, electrical testers, or technical clerks and cost accountants. After a man has been graduated as a machinist, tool and die maker, he may take a further 2-years' course to qualify as a draftsman or tester. The pattern maker has the same privilege. The draftsmen and testers are eligible for a further 2 years' special engineering course.

All work done in the classes is productive. The students are put to tasks of gradually increasing difficulty so that no material is wasted. The products of the school after proper testing are used in the G. E. appliances. It often happens that the work which the students turn out is of unusually high quality in comparison with the work of the less ambitious employees.

Students in training are paid by the hour. The apprentice machinists receive 12 cents per hour at the start of the machinists' course. The scale increases until 20 cents per hour is paid for the fourth year. One hundred dollars bonus is paid to the apprentice upon graduation. The iron molders' wage is a little higher, being from 15 cents per hour at the start to 25 cents at the fourth year. The draftsmen apprentices who are graduated from the other courses get 22 cents per hour the first year and 25 the second with a graduation bonus of $50. The high school boys starting in as draftsmen have a 3-years' course paying from 14 cents at the start to 23 cents per hour for the third year. High school graduates may take the courses open to grammar school boys and receive credit for the first year, making it possible to become a machinist or molder in 3 years.

Laboratories Provided for Apprentices

The shops in which the apprentices work are as large as many a modern factory. The apprentice training room has a floorspace of 36,000 sq. ft. equipped with over $500,000 worth of the best machinery. In addition to the machine shops there are several recitation rooms where classes in theoretical science are held. The apprentices learn not only

the actual operation of machines, but also study arithmetic, algebra, plane geometry, trigonometry, elements of mechanics, power transmission, strength of materials, elementary electricity, chemistry of common metals, mechanical and free-hand drawing, machine and tool design, business English and free hand drawing.

Those who are taking the post-graduate engineering course receive instruction in advanced algebra, plane trigonometry, descriptive and analytic geometry, mechanics and mechanisms, mechanics of materials, magnetism and electricity, machine and dynamo design, heat and heat engines, elementary chemistry and metallurgy, mechanical drawing and business English. The practical training is concerned with assembling, winding and testing of D.C. and A.C. motors, of transformers, meters and instruments and, as far as conditions permit, of other apparatus manufactured by the company. Where practicable, a short assignment in the cost or production departments is included.

Factory Runs Five Restaurants

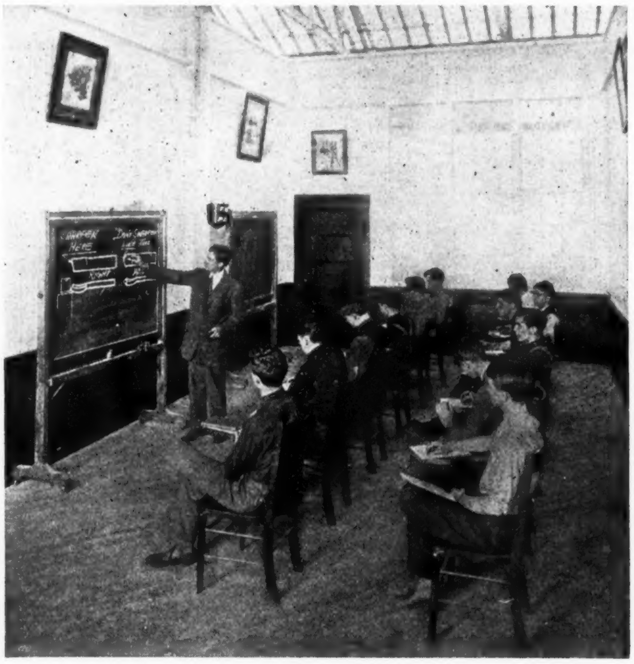
Five restaurants are run by the General Electric company in various parts of the West Lynn plant. Three different systems are used: a table d'hote service in the administration building and firemen's lunch room, a cafeteria service in the men's factory restaurant and the women's department, and a counter system at one of the factory units. These systems have been developed to meet different needs. As a great many hands live in the vicinity of the factory they either eat lunch at home or bring part of it with them. The cafeteria system allows them to get soup or coffee without the expense of buying a whole dinner or paying for waitress service. The counter system is used in a department where quick service is needed, and where it is not convenient to go over to one of the main restaurants. The clerks, executives, stenographers, and others of the administration building however, prefer a table d'hote lunch which is supplied at a charge of 25 cents.

In addition to the lunch-room service there is an evening and a midnight meal service for night force.

Two clubhouses furnish recreation in free hours. The largest of the two clubs is located in a made-over factory building in West Lynn. The company has not put up an expensive outfit here; but it is sizeable and adequate for the purpose. The clubhouse occupies three floors and provides several gymnasiums, one for girls, another for the soccer football team, a third for the apprentices, and a fourth for the inside firemen. There are a number for the use of employees at a cost of 5 cents per string. The clubhouse has an indoor rifle range, the popularity of which has markedly increased since the entry of this country into the war, and a meeting room for dances, conferences, and entertainments which will accommodate from 500 to 600 persons.

There is a smaller clubhouse known as the Thomson Club for the use of the college and university men at the plant.

In addition to the indoor club activities there is much done in outside athletics. The General Electric Athletic Assn. is made up of G. E. workers. Its program is organized by a committee of five from the executive force of the factory. Where any employe is interested in developing a given line of activity, he is appointed a chairman of committee to do the work in which he is interested. Bulletin boards in various parts of the factory buildings are used to inform the force of the recreational opportunities.



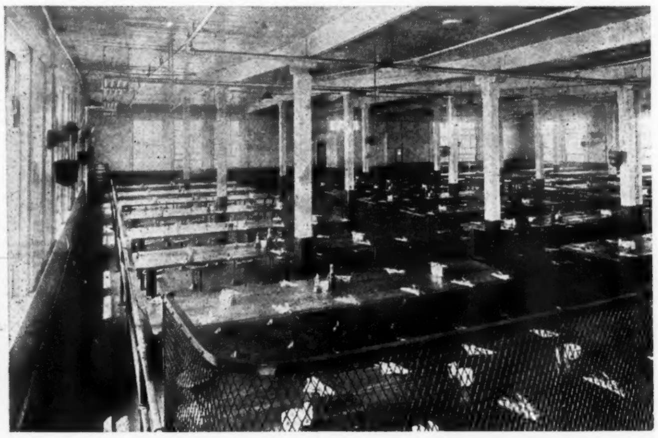
Theoretical as well as practical instruction is given at the apprentice school. This shows a group of young men doing classroom work. They are paid during the apprenticeship period on a schedule rated according to experience and the kind of instruction being given

Soccer football is one of the favorite sports at the factory, though baseball is probably the leader. There is a General Electric team which is of semi-professional ability. In addition to this there is a Sunset League made up of twelve teams from different departments of the factory.

Dispensary Proves Profitable

A modern brick and steel building has been erected in which is housed the dispensary. This feature of the labor department pays for itself many times over. The greatest saving comes in the elimination of unfit workers. There have been many instances in the past where workers have come to the factory with injuries received elsewhere which had not

Lunch is served in this room of the administration building at practically cost to the clerical force and the executive staff. A table d'hote meal is furnished at a charge of 25 cents



Cafeteria service is given in this restaurant for the factory men, as many of them bring the bulk of their lunch and wish to buy only a hot drink or a dessert at the noon hour.

developed seriously, and upon later development entered claims for damages. Such cases are hard to disprove, and the only way to satisfactorily eliminate them is to provide a thorough physical examination before the worker is accepted for a job. The examination also prevents the admission of a person who has a contagious disease.

Any accidents which occur in the factories are quickly attended to by the local medical staff. The dispensary is equipped with an X-ray machine which takes photographs of the injured member, showing if the bone has been broken and at what points.

Compensation for accidents is not regulated by the company, but by the State. Massachusetts has a workmen's compensation law which fixes the amount which the factory must pay the workman for injuries received. This obligation is met in many of the factories by taking out group insurance for their employees. The G. E. is insured by the Massachusetts Employees Insurance Assn. The rates for the industrial insurance policies of this company depend on the number of safety precautions taken. The better the workman is protected from possible injury, the lower the insurance rate.

Safety Devices Built into Machinery

The General Electric Co. builds some of its own machinery, and in the construction the engineers keep the safety factor in mind. The result is that there are few wire cages around flywheels or similar devices seen in many factories to avert accidents. The construction of the G. E. machinery is such that as many moving parts as possible are under cover, so that extra cages are unnecessary. All live wires are insulated.

The danger of fire is minimized in a number of ways. An automatic sprinkler system is installed in all the buildings. The structure of the plant is brick and steel. There are hydrants every few hundred feet in the yard and shops. There are about 150 "call" men working at the plant who are trained firemen. The company has a reciprocal agreement with the Lynn Fire Department whereby its "call" men assist the Lynn fire forces at a big city fire; and in return the Lynn department is available for use in case of a factory fire.

Encouragement for remaining in the service of the company for a long period of years is given by the pension system. All persons who have been in the service of the company for 20 years are eligible to receive pensions upon retiring. The age of retirement for men is 70 years, and for women 65. Or, if the employee is permanently disabled, retirement may be granted at 65 years if a male and 55 years if a female. In some cases of incapacity a pension is immediately granted, but this privilege rests with the discretion of the company.

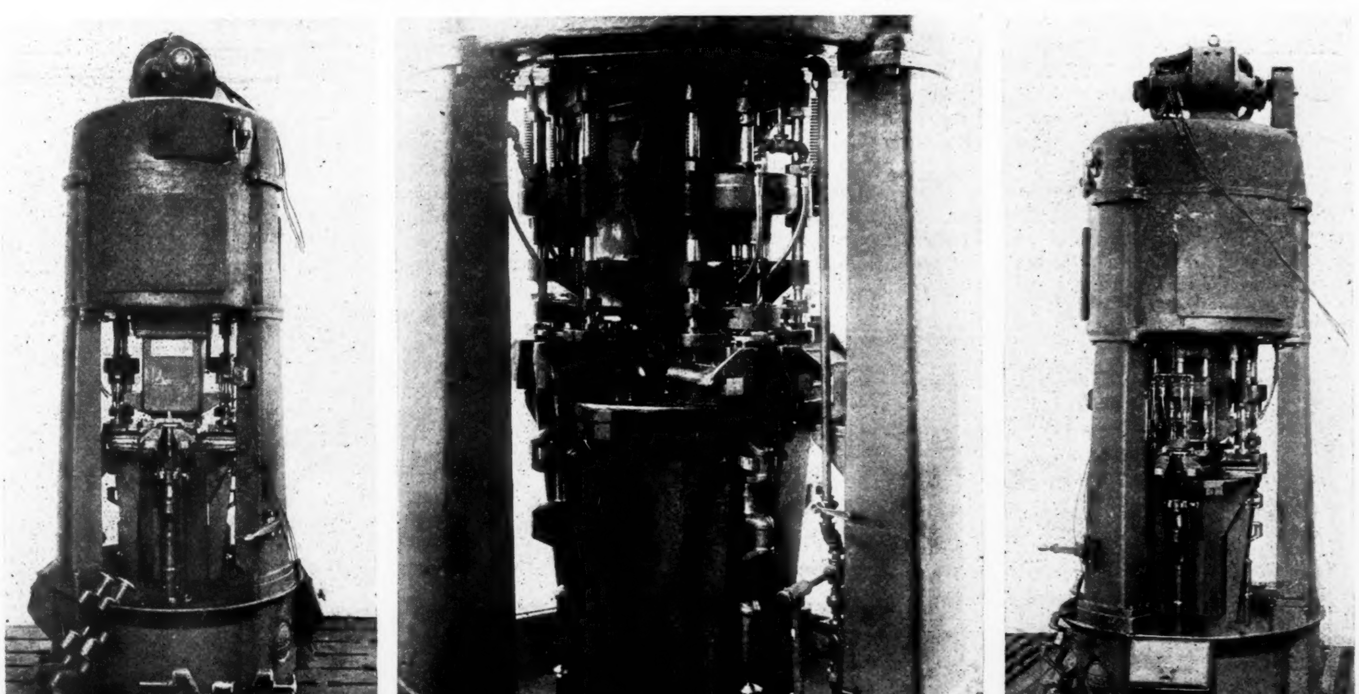
Bonus System for All Employees

A bonus system for all employees has been installed to meet the present era of high prices. Each worker receives 10 per cent of the wages he has earned during the previous month in addition to his regular pay. Those who have been 5 years in the service of the company in addition to the 10 per cent bonus receive a 5 per cent at the end of each 6 months of their wages during that period. High salaried officials of the company are not included in this plan.

Another system for taking care of special emergencies is the G. E. Mutual Benefit Assn., which is a voluntary organization. The members of this body pay 50 cents initiation fee and 10 cents weekly dues. In case of illness a benefit of $6 weekly is paid to male members and $5 to female, and no male member can draw more than $84 or no female member more than $70 annually in benefits. A death benefit of $200 is paid to the beneficiaries of a deceased member. If the treasury of the association reaches a certain top limit the dues of the members are not called for until the treasury has been depleted, when the weekly dues are again collected.

In conclusion, the General Electric system of making work attractive is remarkably complete. The worker is sure to be in good health before he is employed, he is protected by safe guards against accident, he is treated by expert doctors if injured, a mutual association brings financial relief at critical times, a pension provides for old age, clubhouses furnish recreation and an apprentice school gives him a chance to rise.

Machine Drills and Reams Crankshaft Flange in 50 Sec.



This new machine, made by the Bausch Machine Tool Co., drills and reams six holes in a crankshaft flange at a production rate of one shaft each 50 sec. Left is the loading position, center shows drilling and reaming the two locating holes, and right the drilling of the four bolt holes. The fixtures holding the shafts are free to float so as to allow perfect alignment to be obtained after each indexing

Details of the Cleveland Tractor

Lightest Machine of the Creeper or Tracklayer Type—One Forward Speed and One Reverse

THE Cleveland Tractor, which has been developed during the past few years by Rollin White, is now being produced at the rate of forty a week, and by Nov. 1 the floorspace of the Cleveland plant will be doubled and production correspondingly increased.

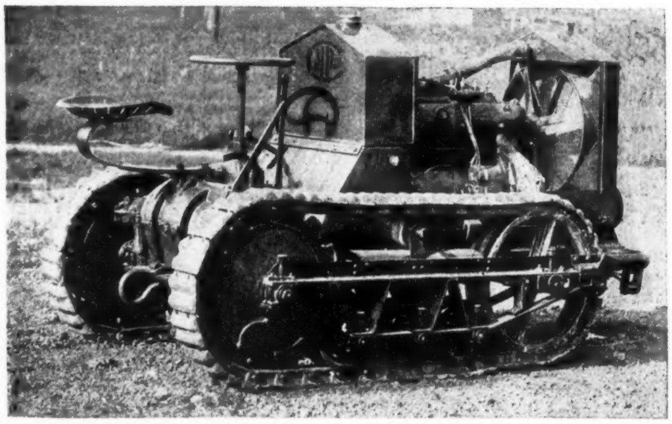
This tractor is of interest because it is probably the lightest weight creeper on the market. It weighs 2750 lb. and is characterized by its small size, being 52 in. high by 50 in. wide. It is rated at 12 hp. at the drawbar and 20 hp. at the pulley, and with its creeper type of tread, 600 sq. in. of traction surface is provided. The overall length of the tractor is 96 in. The complete machine sells for $1,185 f.o.b. Euclid, Ohio.

The tractor is characterized by its compactness, and, as may be seen from the illustrations, the power plant is set well back toward the center of the creeper drive; thus the traction surface carries the weight well toward its center, so that a maximum tractive effort can be secured. The radiator, which is at the front of the tractor, is the only part projecting forward of the driving wheels, and at the rear the driver is seated slightly behind the rear axle. This gives a balanced layout which distributes the weight quite evenly along the surface of the creeper mechanism.

The framework of the tractor is made up of two side bars mounted on trunnions at the rear axle, and the crankcase, transmission and rear axle housings also have their value as structural supports. The effect of three-point suspension is secured by having the rear connections of the side bars mounted on trunnions, and in front these are connected with the cross spring by means of shackles. This gives a flexible drive which allows the tractor to work to advantage on unequal stretches of ground.

The engine is a Buda model R, 3½ by 5¼. The characteristics of this engine are such that with the gear ratio used on the tractor an efficient working speed is had at 3½ m.p.h., with a maximum working speed of 4 m.p.h. The revolutions per minute of the engine are 1450 at 4 m.p.h. and 1272 at 3½ m.p.h.

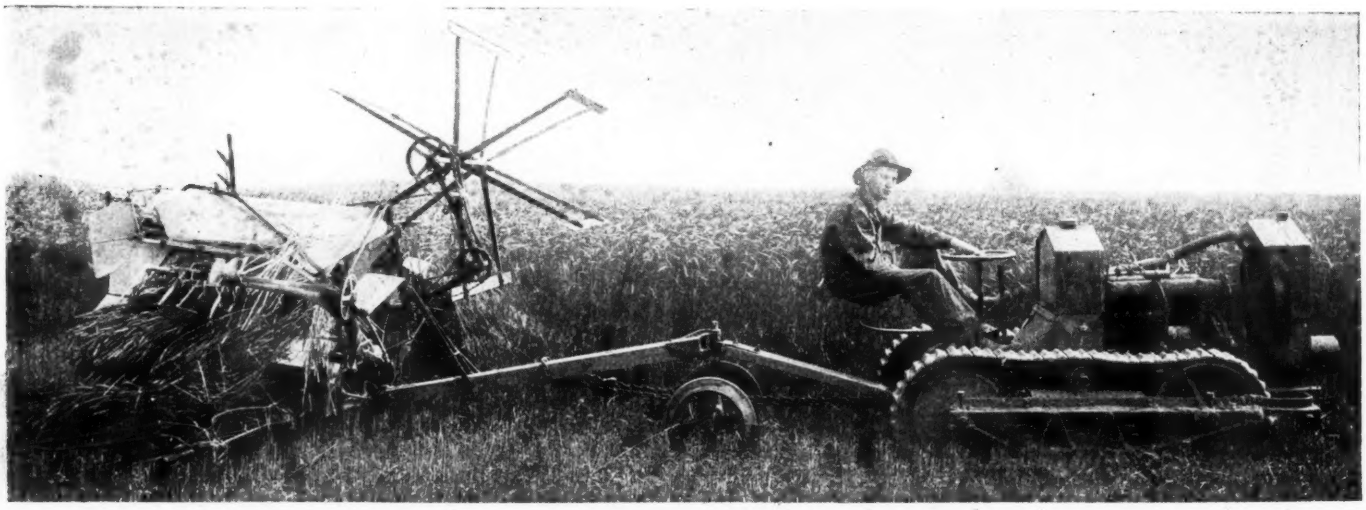
From the engine the drive is transmitted through a Borg & Beck dry plate clutch to a transmission unit or reversing gear developed at the Cleveland Tractor Co., affording one speed forward and one reverse. The reduction is 25 to 1 in either case. From this unit the drive is transmitted through bevel gears to the axle which transmits the torque to the creeper mechanism. The belt pulley is 8 in. in diameter and has a 6-in. face. The width of the track is 6-in. and the length 50 in., giving 300 sq. in. of traction surface on each side of the machine.



Cleveland creeper type tractor, showing small size

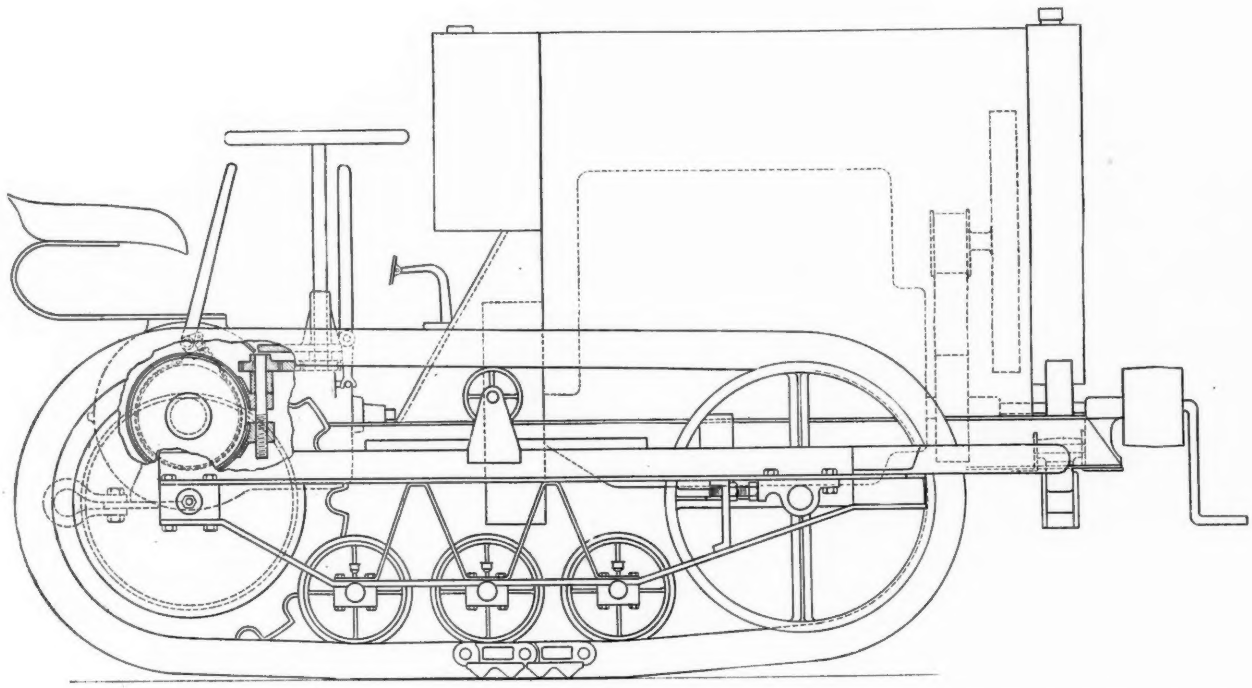
The fittings of the tractor are standard, the carbureter being a Kingston fitted with a Bennett air cleaner; the magneto is an Eisemann, and the radiator a built-up cellular type. The gasoline tank is mounted just behind the engine and forward of the steering wheel, the latter being mounted upon a vertical steering post with the driver seated on a support mounted at the end of a flat steel bracket which acts as a spring.

One of the features of the machine is the steering gear arrangement, by means of which a train of gears is operated by the steering wheel, and these in turn apply a brake to one side or the other of the axle. This slows up the creeper belt on one side of the machine, allowing the other to go ahead at a speed ratio corresponding to the resistance placed upon the opposite member by the brake pressure. When the brake is applied so that one belt is stopped, the reduction is 1½ to ½, or in other words, 3 to 1, due to the differential gears. The actual drive connection between the rear axle and the creeper wheel is by means of an internal gear. The emergency brake is applied against a band mounted on the outside of the differential drum, as indicated in the accompanying drawing. The pitch of the creeper shoes is 4½ in., and there are sixteen sprocket teeth in the drive wheel. The tractor clearance is 12 in.

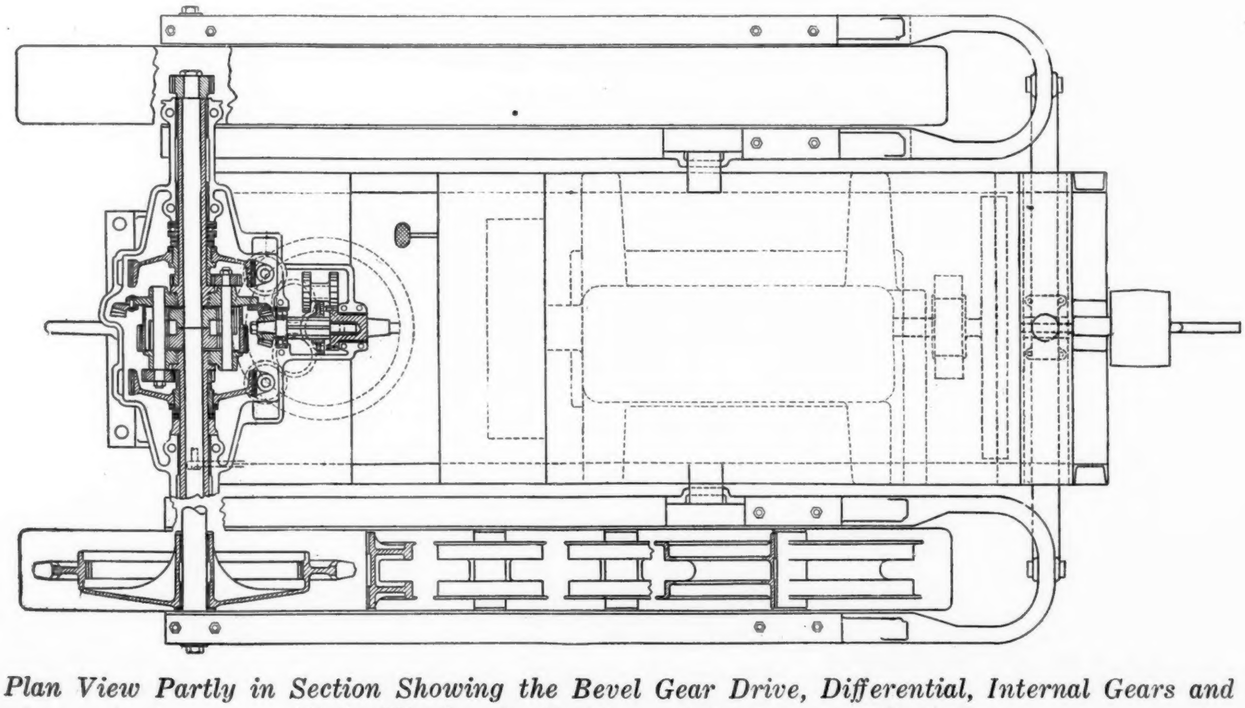


Cleveland tractor at work drawing a binder. It can also be used for industrial purposes

The Cleveland Creeper Type Tractor



Side Elevation Showing Frame Construction, Form of Creeper Links and Method of Steering by Applying a Brake to One Side of the Differential Drive



Plan View Partly in Section Showing the Bevel Gear Drive, Differential, Internal Gears and Chain Wheels; also the Form of the Creeper Wheels

Making Hot Bulb Engines Controllable

Experiments of British Engineer Show Small Changes Affect Performance—How to Obtain Best Combustion of Heavy Oils

DESPITE the fact that it is an old type, the hot bulb engine is only in a partially developed state. It is the only existing type of engine which burns liquid in liquid form and is also possible of application to a vehicle, for the full Diesel with its high pressure for injection is altogether too complicated for automotive purposes and is uncontrollable in small sizes.

It is a recognized fact that hot bulb engines vary a great deal in their success, and that small variations in the proportions may have great effects on the operation. In the following article, extracted from *The Engineer*, London, the importance of proper relative positioning of injector and hot bulb is well shown.

To Get Complete Combustion

With the hot bulb engine it is always a matter of considerable difficulty to get absolutely complete combustion of the fuel oil. In many instances the writer has been able to get engines the exhausts of which were as nearly perfect as any hot bulb engine can ever hope to be, but after a few weeks running a dirty exhaust developed, which was due mainly to the unskilled and cheap labor available for attending to the engines. In a pure Diesel engine, where highly compressed air is used to pulverize the oil, the problem is rather simpler, and perfectly smokeless combustion, even with the heaviest class of fuels, can be got, and consequently a low fuel consumption registered, despite the fact that 8 or 10 per cent of the engine power is used to drive the injection air compressors.

In all engines that inject the oil direct into the cylinder with a pump, the oil enters as a jet, and as it is in a more or less solid form, it is extremely difficult to obtain smokeless combustion, owing principally to imperfect pulverization, causing the particles of oil to be too large to burn completely during the short period the oil is in the cylinder. This system is called the solid injection system, and may be applied to pure Diesel engines as well as to hot bulb motors, highly compressed, and therefore highly heated, air being used for ignition instead of the hot bulb.

The effectiveness of the air injection system as compared with the solid injection system for obtaining a smokeless exhaust can be easily understood. With the solid injection system, even under very high pressures, the fuel moves at a comparatively slow speed when emerging from the jet, and thorough mixing with the air in the cylinder cannot be obtained. If the nozzle is of an imperfect form, there is also a danger of the oil carrying over too far and depositing on the sides of the combustion chamber.

Dribbling at the Jet

It is also easy to see that there must be a certain amount of dribbling at the jet during the time the oil column is accelerating to get up sufficient speed to carry it into the combustion chamber, and also when it is decelerating or finishing. These drops fall on the piston and water-cooled parts of the engine, where they cannot be properly vaporized or burned, so that a smoky exhaust results and the piston rings and combustion spaces get clogged up with unburnt carbon.

With air injection the speed of the oil is easily five to ten times greater than with solid injection, and the oil is broken up into very much finer particles. It is, therefore, possible to get great turbulence and mixing in the combustion spaces, giving high mean pressures and clean combustion.

A rather complete series of experiments was carried out by the author on a large hot bulb engine to determine the best form of bulb, and, if possible, evolve a type that would not require the water drip to keep the bulb at the proper temperature. Both air and solid injection systems were tried, and whilst no absolutely uniform conclusions can be drawn from the experiments, they determined forms that could safely be claimed as smokeless, with certain classes of heavy oils. It was also found that when new sizes of engines were built embodying the best results, some of them did not come up to expectations, whilst others exceeded the best that had been obtained, thus illustrating the often repeated statement that each size of each type of oil engine is a law unto itself. Some peculiarities were also discovered that should be of great assistance to any designers in this class of work, and should prevent an unnecessary repetition of the same experiments.

Fig. 1 shows a section of an ordinary crankcase-compression two-cycle hot bulb motor. This particular engine was fitted with a two-stage air compressor having inter and after-coolers, the injection air being compressed to 500 lb. per square inch, this pressure being sufficient to overcome the maximum explosion pressure of 350 lb. per square inch occurring in the cylinder. The cylinder cover was water-cooled, and the injection valve was placed horizontally in it, so that it was necessary to deflect the jet up into the bulb by drilling the nozzle hole at an angle.

In all the designs of hot bulb motors with water-cooled cylinder covers, the bulbs are very small as compared to those, see Fig. 2, in which the bulb and cover are made as one uncooled casting. The bulbs are therefore very cheap to replace, and as the air in the cylinder is kept cooler by the cover it is denser, and consequently a higher mean pressure can be supported and a more powerful engine offered. This was clearly proved from the experiments, and the practice is now being followed by many manufacturers.

Bulb for Air Injection Type

For the air injection type, the form of bulb shown in Fig. 1 was found to be the best and most durable, and practically all classes of fuel could be smokelessly consumed. In addition, it was possible when the correct compression was found —about 140 lb. to 150 lb. per square inch—to run at full speed without the aid of a water drip to regulate the temperature of the bulb. It did not show any signs of overheating or wear, and, if necessary, could take a considerable quantity of water, sufficient to give an increase of 20 per cent in the power, without in any way causing the engine to misfire by cooling the bulb too much.

The water-cooled cylinder cover possesses an advantage not given by any other type, which is very convenient should the supply of water give out. It will be noticed that the air is compressed into the bulb through a water-cooled throat. By regulating the temperature of the water round the throat, the temperature of the bulb can be kept within all practical limits. When it is required to do this, a water pipe with a valve in it should be taken direct from the cooling pump to the cover, so that the coldest water is available. The usual practice is to take the water from the cylinder jacket into the cover, but this water is too warm, when it is desired to use this system of bulb temperature regulation.

Nothing in the nature of dribbling at the jet occurs, as the air blows all the oil in and leaves the end of the nozzle clean, and the valve seat free for the valve to seat sharply. Certainly, the air compressor adds a complication to the engine and makes it more expensive to manufacture. On the other hand, it gives a more powerful engine and a clean exhaust, and no serious clogging of the piston or bulb occurs, so that overhauls are rendered less frequent.

As a rule, it is safe to estimate an increase of 15 per cent in the power over solid injection engines, and the price can,

accordingly, be advanced by that amount, which more than pays for the complications added by the compressor. On the other hand, it requires a more intelligent driver to operate the engine, and this type should only be installed where good attention can be given. It is also better adapted for the larger sizes of engines, and it is the writer's opinion that it should not be fitted to engines giving less than 40 to 50 brake horsepower per cylinder.

Practically speaking, any form of bulb, Figs. 1 to 6, can be used for air injection, and in every case smokeless combustion can be obtained without any great deal of experimenting. It was found that the testing expenses and time required for tuning up was less for a new size of engine of this type than for a new size of the solid injection type.

Any Form of Bulb Suitable

For the solid injection experiments the form of bulb shown by Fig. 2 was tried. Although this form is used with great success on a famous engine, it was found in the present experiments to be by no means the best. It was rather smoky, and for reasons already given, the power also was not high. The fact that a certain proportion of the air in the passage leading into the bulb furthest away from the jet cannot be directly attacked by the oil jet, would, no doubt, tend to keep down the mean pressure. This type proved to be rather costly to make and to renew when any cracks developed.

The type shown by Fig. 3 easily gave the best results, despite what might be thought to be some serious drawbacks. For instance, the jet is situated in the cylinder jacket, and the oil has to travel through the long water-cooled hole in the cylinder cover before reaching the hot bulb. It would be natural to expect some dripping of the oil column on to the piston and cover, and, consequently, incomplete combustion and a smoky exhaust. On the contrary, with paraffin, shale oil, and gas oil, the exhaust was perfectly clean, full power was obtained without the assistance of the water drip, and no overheating of the bulb took place. With the water drip, an increase of 25 per cent in the power was easily maintained for long periods, and without the expenditure of any additional fuel oil.

The reason why this type of bulb keeps cool without the water drip is to be found in the fact that the whole of the flange of the bulb is in contact with the water-cooled cover. Should the bulb tend to keep cool its temperature can be nicely adjusted by relieving some of the flange, so as to reduce the surface in contact with the water cooling of the cover.

The power obtained from this type was only excelled very little by the air injection engine, and the bulbs proved to be very durable. The good results obtained from this bulb led the designers to think that better could be got by greatly reducing the distance the oil had to travel before reaching the bulb, and the form shown by Fig. 4 was tried, in which the nozzle is placed in the cylinder cover and much nearer to the bulb than it was in Fig. 3.

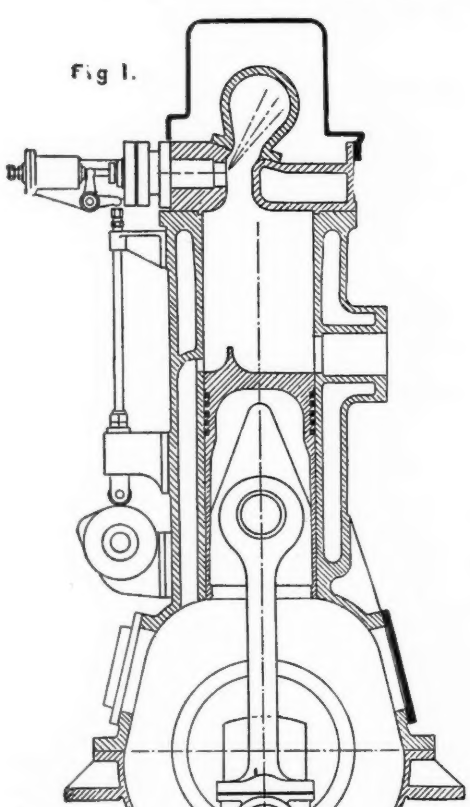
It would be as well to point out that the object aimed at in the bulbs shown by Figs. 3 and 4 was to inject the oil at a tangent to the inner surface of the bulb, and get a concentric swirling action to assist the mixing and combustion of the charge.

An Unexplained Failure

For reasons which could not be fathomed or even partially explained, this one, Fig. 4, was a comparative failure, and gave nothing like the results of the one shown by Fig. 3, notwithstanding the fact that everything had been done to keep the compression and all else the same, in order to make the experiment a success.

The variation shown by Fig. 5 was next tried, but again failure was registered, and no satisfactory explanation could be offered. Repeatedly the writer has been faced with this inability to offer a suitable explanation for a failure in oil

Fig 1.



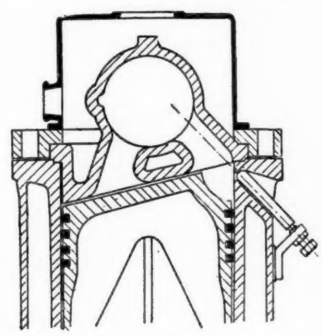
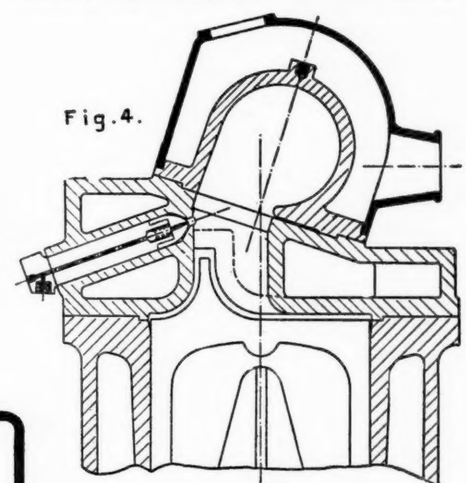


Fig 2

Fig.4.



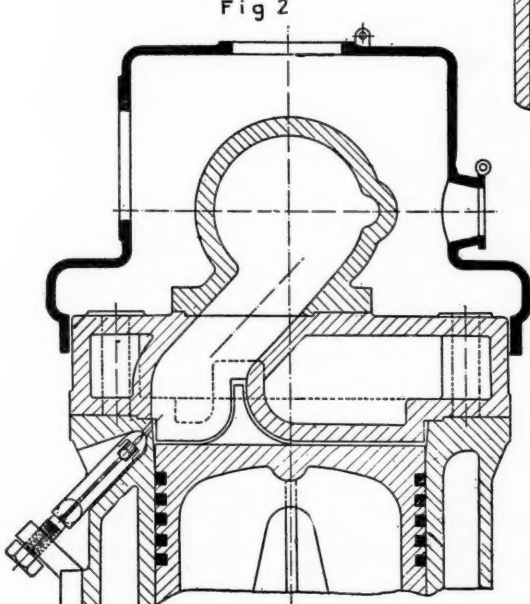


Fig.3.

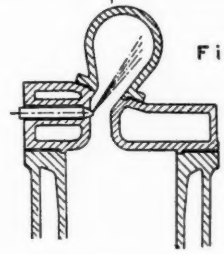


Fig.5.

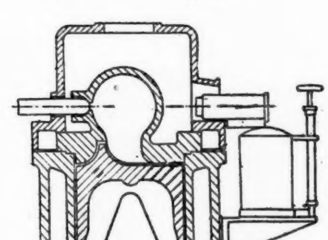


Fig.6.

Various forms of bulbs used for hot air injection. With each type illustrated smokeless combustion was readily obtained

engine work—especially with the solid injection system—when everything pointed to success. It only goes to show that the margin between success and failure is very little.

Nozzle Directly in Bulb

The idea was carried a bit further and the nozzle put directly in the bulb, as shown by Fig. 6, but with no better success. During the design of this type various faults were obvious, but it was very much desired to try the experiment, and if it had succeeded some of these faults could easily have been eliminated. For instance it was seen that the force required to press the nozzle against the bulb to make a joint would be great enough to distort the bulb, when it was at a dull red heat. This actually happened, and in time the bulb gave way at the neck. This, of course, could have been obviated by pulling the jet against the bulb by means of studs screwed into the bulb instead of into the adjacent cast iron cover. Then, again, the heat of the bulb kept the nozzle very hot, and the oil gasified before issuing to the cylinder, with the result that the hole was not big enough to pass the required amount of oil, and after the engine had been working a short time the power fell away.

This could have been overcome by putting a water-cooled cage into the bulb to carry the nozzle, but complicating the bulb in this manner would render it liable to crack and become distorted when it got hot.

The Standard Adopted

The poor results obtained from the initial experiment did not justify any more money being spent in this direction, and the idea of putting the nozzle direct in the bulb was abandoned. From the all-round results of the solid injection experiments, the form shown by Fig. 3 proved to be easily the best, and was therefore adopted as a standard.

A New Piston Valve Engine

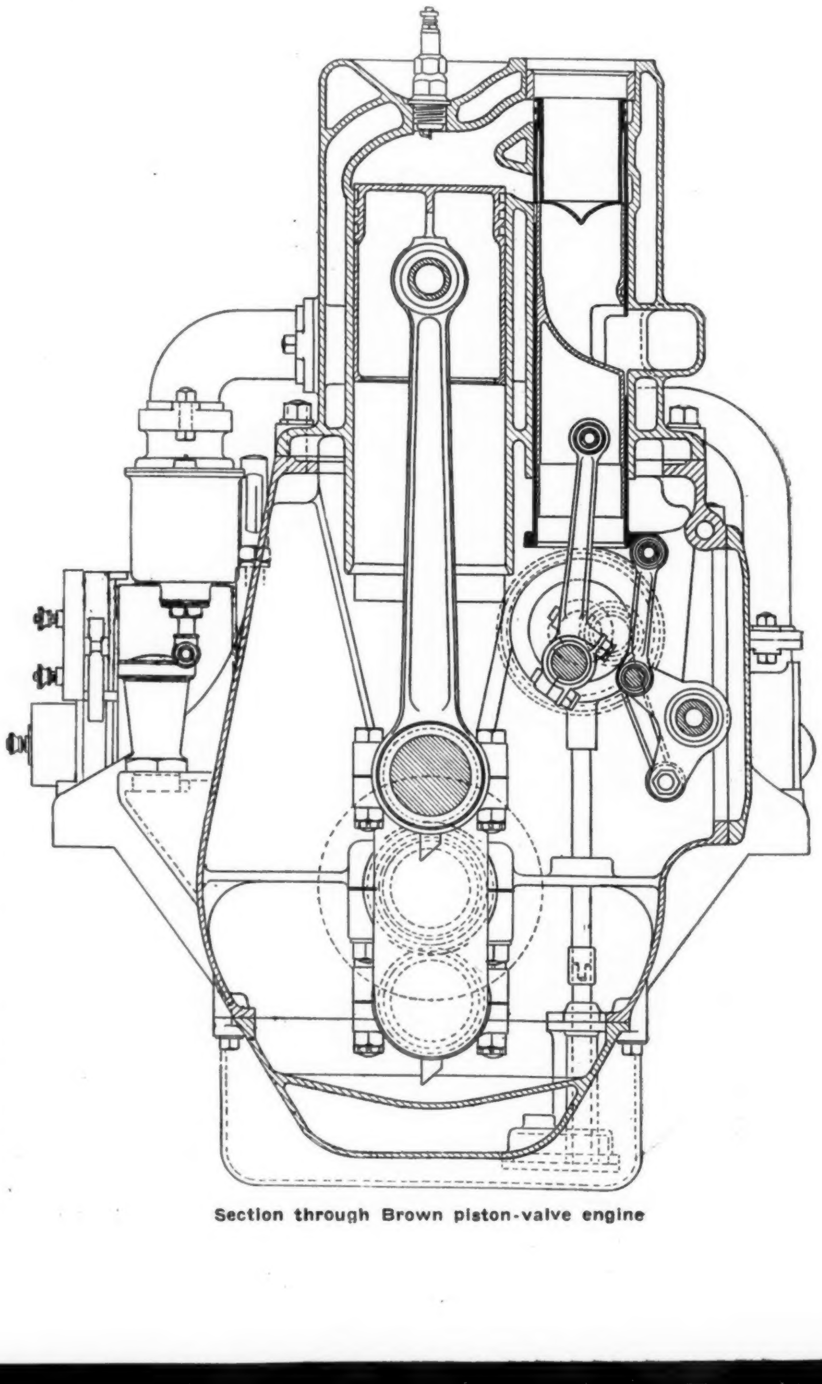
PISTON valve engines are comparatively new in the automobile industry, for with the exception of one made in Pittsburgh, Pa., it is doubtful whether any have ever been applied to automobiles in this country. A piston valve engine of interesting design is being developed by Brown Motors Co., 209 Reliance Bldg., Moline, Ill. The company does not intend to manufacture this engine, but to develop it experimentally and issue licenses for its manufacture to interested concerns.

The engine generally is of automobile design and has a valve barrel parallel with the working cylinder on one side. In this valve barrel reciprocate two valves which are operated from an eccentric shaft. One of the valves is in the form of a sleeve and is operated from this eccentric through the intermediary of two connecting rods or links and a bell crank, while the other is operated directly through a connecting-rod. There are two passages from the combustion chamber to the valve barrel, the upper being the exhaust port and the lower the inlet port. The exhaust port is opened by the upper edge of the exhaust valve uncovering it and the inlet port is opened when the ports in the two concentric valves register with it. There is another port in both of the valves at a lower level which registers with a port communicating with the inlet manifold.

The whole crankcase is made in a single casting, with the exception of the oil sump, which is bolted on. The cylinder block is bolted to the crankcase by means of a flange at the lower end of the water jacket, and the cylinder barrel extends a considerable distance into the crank chamber.

It is claimed that the valves are balanced and require very little power to operate them. When the charge is fired the valves are practically at rest. The valves are positively driven and are always correctly timed irrespective of the speed of the engine. Intake and exhaust port openings are larger than on other engines. The valves, of course, are silent in operation; they are very accessible and are impossible to overheat.

An inspection of the cross-sectional view herewith brings out the fact that the engine is of modern design. Its crankshaft is supported in three main bearings, the crankcase being heavily ribbed so as to insure rigidity. The valve operating shaft is driven from the crankshaft through a silent chain so as not to lose the advantage of silent operation inherent in the valve construction through the use of noisy gears. There is a large opening in the crankcase at the side where the valve operating shaft is located. Means are provided for driving the magneto from a cross-shaft, this insuring accessibility of the main working parts and permitting of easy removal and replacement of the whole machine.



Section through Brown piston-valve engine

Steels Used in Airplane Work—V*

Heat Treatments and Their Effects on Various Steels—Machining of Heat-Treated Steels—Case Hardening

By Dr. W. H. Hatfield*

THE terms "normalizing" and "annealing" are loosely applied to a variety of operations in a steel works. Steel in the forged or rolled condition is in a strained state, and, in order to destroy the stresses remaining from these operations, it is necessary to reheat the material. This may be accomplished by either of the operations under discussion, but in addition to the necessity for removing stresses it is often necessary also to soften the material by entirely modifying its structure. The actual operation of normalizing consists in heating the steel above the Ac3 point and allowing to cool in air free from draughts. Annealing is a much more thorough treatment, involving a knowledge of the behavior of the various steels under varied conditions. The original method of annealing was to heat the steel to a high temperature, maintain that temperature for a varying time, and cool very slowly. This is quite satisfactory for many steels, but in some of the alloy steels better results are obtained by heating to temperatures below the carbon change-point and cooling in air or in the furnace. It may be of interest to include the I.A.E. Steel Research Committee's definition of these terms:

NORMALIZING.—Normalizing means heating a steel (however previously treated) to a temperature exceeding its upper critical range and allowing it to cool freely in the air. The temperature shall be maintained for about 15 min., and shall not exceed the upper limit of the critical range by more than 50 deg. C.

ANNEALING.—Annealing means reheating, followed by slow cooling. Its purposes may be:

(*a*) To remove internal stresses or to induce softness, in which case the maximum temperature may be arbitrarily chosen.

(*b*) To refine the crystalline structure in addition to the above (*a*), in which case the temperature used must exceed the upper critical range as in normalizing.

Hardening and Tempering

For many centuries swords, knives, and similar articles have been hardened and tempered, and the "finely-tempered" sword, an article in past ages much in demand in times such as these, was produced long before pyrometric observations and the science of metallography had explained the fundamental principles of such processes. In considering the hardening and tempering of steel parts for aero and automobile work, we are only following the example of the time-worn procedure of the old cutlers and armorers. Now, be it noted that a novice would never in the old days have been permitted to harden and temper, only the highest skill and experience permitting the production of the desired results, and to-day the same remarks apply. There is quite enough scope in the art of hardening and tempering small parts, such as used in this and other branches of engineering, to justify the growth of a class of operators with brains to understand and skill to execute the treatments required to obtain those excellent qualities which skillful hardening and tempering will induce. Bearing on this, it not infrequently happens that small parts are required in which one portion will have to be finally tempered and toughened, while the other is quite hard, and even more difficult requirements can be met, provided the development of the necessary technique in the operator is insisted upon. In the whole range of steel metallurgy there is no direction where careful study and good technique can produce more valuable results.

*Paper presented before the Aeronautical Society of Great Britain, slightly condensed.

The operation of hardening consists of quenching after raising the steel to temperatures above the critical point at which it will exist as solid solution. In dealing with parts made of 0.3 to 0.4 per cent and under of carbon, it is not only sufficient to raise to a temperature at which the solid solution areas are formed, but the temperature must be attained at which the ferrite has also disappeared, owing to its solution in the solid solution. The desirable temperature, therefore, for hardening is that at which you quench the steel as a homogeneous solid solution. If you do not go to temperatures sufficiently high for this, you simply obtain patches of ferrite, which reduce the effectiveness of the whole operation of hardening and tempering. Generally, temperatures from 800-850 deg. C. are quite sufficient for this operation, but the actual temperature depends upon the steel, and in this connection it is particularly important that the operator should appreciate the temperatures at which the changes take place in the given steel. It might be well here to caution against the use of too high quenching temperatures.

(1) If the temperature is taken too high an undue brittleness is introduced into the steel.

(2) Quenching from higher temperatures naturally means greater internal stresses.

(3) If too high temperatures are employed, the quenching medium, if of limited volume, becomes heated to a greater temperature during the quenching operation, and is, therefore, less effective in quenching the material, the speed at which the article passes through the critical zone being most important.

While discussing hardening, it might be well to point out that rapid heating should for obvious reasons be avoided. It will be remembered that, in speaking of "factors of safety," the question of hardness cracks was brought in, and it might here once more be emphasized that carelessness in hardening and tempering may vitiate the results of most excellent insight and care in design. It will also be fully appreciated that in the hardening operation sharp corners, angles, etc., are a disadvantage just as in other items of process to which reference has been or will be made.

With regard to the medium employed for hardening, that is determined by the character of the steel, and may either be water, oil, or air.

The tempering operation, resulting in the degree of softening required, depends upon the particular temperatures to which the hardened part is submitted, the reheating causing the breaking down of the hardened state of the steel. There is not time in this short paper to discuss the theory of the matter, and it will perhaps be well now to give typical examples of what the effect of tempering at various temperatures may be on specific steels. It is proposed to take as examples a carbon steel, a nickel-chrome steel, and a high-chrome steel. Particulars of series of such heat treatments are given in the accompanying tables.

These figures will illustrate the different responses which these types of material make to similar heat treatments.

Before leaving this part of the subject, a word or two might be said on air-hardening. Owing to the composition of such material, the critical changes become so sluggish that merely heating up to a certain temperature and cooling in air is sufficient effectively to produce the hardened condition. This property also allows of larger objects being hardened throughout, and, incidentally, owing to the less drastic effect, does not so easily result in cracking. Air-hardening steel after forging and rolling is already in such a hardened state that tempering alone will put it into fairly good condition. It might also be pointed out that since billets and forgings, after

working, are hard, they should only be heated slowly and with the utmost care; rapid heating causes a good deal of trouble.

Machining Properties

There are a few difficulties which arise in connection with machining. For instance, if the tensile of the material exceeds 60 tons per sq. in., machining becomes very difficult, and if much higher tensiles are required it is necessary to heat treat the material afterward. (For parts which have to be hardened after machining the material can be worked in a soft condition with accuracy and speed.) For complicated parts this introduces difficulty owing to the distortion, etc., produced in final heat treatments, but these troubles are now being largely diminished, and, after all, much depends upon the steel chosen and methods of working. One interesting point which is fully deserving of discussion is the apparent fact that the Brinell figure does not necessarily indicate the ease with which the material will machine. When one considers actually what takes place during machining—*i.e.*, the manner in which local stresses and deformation, ending in the complete separation and rupture of the turnings, take place—it certainly would appear that there are steels and conditions of steels with which it could not be expected to have a definite indication of the machining properties from the Brinell hardness numbers (manganese steel, in the toughened condition, being one abnormal case in point). Sometimes trouble is encountered owing to the material being too soft; for instance, in the machining of aero cylinders the material will drag if the Brinell hardness number be below a certain figure, but a good deal of this difficulty can probably be got over by modifying the angles to which the cutting tools are ground. The speed, too, at which the work is done in such a case is a factor. If, however, in the case of carbon steel the Brinell is studied it will not be proved unreliable, as experience shows that with such steels a careful check of the hardness by this method will result in solving the trouble. It is interesting to record that with the mildest steels the actual size of crystal and amount of inclusion influence the machining properties of the material.

CARBON STEEL

Size of Test Piece, 2 in. ×.564 in. Size of Piece treated, 1 in. round ×8½ in. long

Treatment	Y. P.	M. S.	E. %	R.A. %	Izod Impacts
As annealed	16.93	30.95	31.0	49.7	26, 21, 25
½ hr. 850° C. and cooled in air					
W.H. 850° C. temp. Nil	—	50.47	15.0	33.47	19, 23, 16
W.H. 850° C. temp. 1 hr. 100° C	—	49.59	15.0	40.51	23, 19, 22
W.H. 850° C. temp. 1 hr. 200° C	—	49.44	14.0	34.91	16, 18, 25
W.H. 850° C. temp. 1 hr. 300° C	—	46.55	17.5	39.13	21, 17, 28
W.H. 850° C. temp. 1 hr. 400° C	—	51.26	16.75	39.13	21, 27, 33
W.H. 850° C. temp. 1 hr. 500° C	31.51	47.21	20.0	49.7	34, 35, 31
W.H. 850° C. temp. 1 hr. 600° C	30.12	42.3	25.5	61.48	56, 68, 53
W.H. 850° C. temp. 1 hr. 700° C	24.41	36.27	33.0	69.77	84:86+28:82

HIGH-TENSION STEEL, NI.-CR.

Size of Test Piece, 2 in. ×.564 in. Size of Piece treated, 1 in. round ×6½ in. long

Treatment	Y.P.	M.S.	E. %	R.A. %	Brinell	Izod Impacts
A.H. 800° C. temp. Nil	41.37	56.46	19.0	49.70	3.9	18, 22
A.H. 800° C. temp. 1 hr. 600° C.	37.02	46.49	24.0	63.65	4.3	85, 85
A.H. 800° C. temp. 1 hr. 650° C.	33.08	43.73	26.75	65.76	4.4	86.10:86.11
O.H. 800° C. temp. 1 hr. 300° C.	82.73	89.61	13.0	54.60	3.2	4, 4
O.H. 800° C. temp. 1 hr. 400° C.	72.09	78.98	15.5	58.11	3.4	14, 13
O.H. 800° C. temp. 1 hr. 500° C.	59.88	64.83	19.5	62.58	3.6	54, 55
O.H. 800° C. temp. 1 hr. 600° C.	49.32	55.15	23.0	63.65	3.9	71, 75, 74
O.H. 800° C. temp. 1 hr. 625° C.	46.28	52.89	24.0	65.76	4.0	78, 77, 78
O.H. 800° C. temp. 1 hr. 650° C.	39.79	50.54	25.5	65.76	4.05	81, 79, 79
O.H. 800° C. temp. 1 hr. 675° C.	35.45	51.71	23.0	58.11	4.0	59, 63, 65
O.H. 800° C. temp. 1 hr. 700° C.	34.66	53.54	23.0	47.15	4.0	56, 55, 53
O.H. 800° C. temp. 1 hr. 725° C.	40.18	58.69	19.0	36.34	3.9	43, 40, 48
O.H. 800° C. temp. 1 hr. 750° C.	40.18	59.33	17.0	33.47	3.9	23, 20, 21
W.H. 800° C. temp. 1 hr. 600° C.	51.33	56.64	24.0	64.71	3.9	73, 76
W.H. 800° C. temp. 1 hr. 625° C.	47.59	53.06	24.0	65.76	4.0	86, 85
W.H. 800° C. temp. 1 hr. 650° C.	44.12	51.80	26.0	67.80	4.2	85, 86

STAINLESS STEEL

Size of Material, 1⅛ in. round ×7½ in. long

Treatment	Y.P.	M.S.	E. %	R.A. %	Brinell	Izod Impacts
A.H. 875° C. temp. 1 hr. 500° C.	70.9	85.9	13.0	40.5	3.12	—
A.H. 875° C. temp. 1 hr. 600° C.	44.5	53.6	21.0	59.2	3.9	69, 73, 69 and 59
A.H. 875° C. temp. 1 hr. 700° C.	31.6	45.2	26.0	64.6	4.25	86+ 3, 86+13, and 86+17.
A.H. 875° C. temp. 1 hr. 750° C.	29.5	43.9	28.0	63.6	4.25	86+16, 86+26, and 86+25.
A.H. 875° C. temp. 1 hr. 800° C.	31.6	43.3	27.0	64.7	3.7	33, 33, 43
O.H. 875° C. temp. 1 hr. 500° C.	72.6	90.5	8.0	18.23	3.1	—
O.H. 875° C. temp. 1 hr. 600° C.	39.4	52.0	20.0	56.9	5.9	72, 67, 76
O.H. 875° C. temp. 1 hr. 700° C.	34.8?	47.1	25.5	63.8	4.07	84, 86, 86
O.H. 875° C. temp. 1 hr. 750° C.	39.4	44.1	27.0	66.3	4.2	86+33, 86+29, and 86+42.
O.H. 875° C. temp. 1 hr. 800° C.	59.1	71.6	4.0	11.7	3.67	24, 24, 18
W.H. 875° C. temp. 1 hr. 500° C.	70.9	90.2	12.0	34.2	3.1	—
W.H. 875° C. temp. 1 hr. 600° C.	40.3	53.9	22.0	59.8	3.87	83, 80, 80
W.H. 875° C. temp. 1 hr. 700° C.	29.5	45.8	25.8	64.7	4.1	86+35, 86+34, and 86+24.
W.H. 875° C. temp. 1 hr. 750° C.	30.0	43.7	27.0	65.2	4.22	86+12, 86+15, and 86+19.
W.H. 875° C. temp. 1 hr. 800° C.	30.6?	48.0	18.0	59.2	4.3	86+39, 86+34.

Case-Hardening

The process of case-hardening is employed when it is desired to obtain a hard shell supported on a tough interior. There are several parts in aero work for which this process is used, and it is therefore proposed to discuss briefly the principles involved. The properties ultimately required in the core largely determine the type of steel which may be selected, although the quality of the hardened case also determines the material available. For instance, if the hardest of cases is required it would not be desirable to use a case-hardening steel high in nickel, since experience indicates that the presence of nickel measurably reduces the maximum hardening effect which can be obtained in the case. It will be necessary, therefore, to study carefully the general properties required in the final article before a decision is made with regard to the steel to be employed. When the objects are ready for case-hardening they are packed in a suitable carburizing medium and raised to temperatures of 900-950 deg. C., at which they are maintained for the time necessary to give the required depth of case. This period may be anything from 2 to 12 hr.

From remarks made earlier in this paper it will be apparent that when a temperature of 900 deg. C. is obtained the steel of which the article consists will structurally have become a homogeneous dilute solid solution of carbide in iron, the iron then being in the condition in which it will dissolve very much more carbon than that originally contained in it. The result is that on being placed in such a condition in contact with the carburizing medium, solid or gaseous, carbide of iron is synthetically produced where the article and the medium are in contact, and then this carbide is systematically dissolved and diffused into the steel. Since, if equilibrium were allowed to be attained, *i.e.*, if the steel were allowed to dissolve as much carbon as its condition at such temperatures would permit, it would become to all intents and purposes a steel of high carbon content throughout its thickness; it is necessary to determine by experience with the particular materials employed how long exposure is required just to produce the requisite thickness of case. After the required time at the carburizing temperature the steel obviously consists of a shell of solid solution high in carbon, with a core of solid solution low in carbon, and so on cooling down we have different changes in structure in the two materials, pure iron (ferrite) crystals making their appearance in the core, while the case persists as a homogeneous solid solution (apart from the separated excess carbide existing in it) right down to the carbon change-point. When cold, as time has not permitted the carbide to diffuse into the core of the mass, we have in the central portion approximately the original structure. Experience teaches us that the carburizing operation leaves the core in a coarse condition, and it is, therefore, desirable to reheat the articles to a temperature of 850-900 deg.

C., followed by cooling in air or by quenching as a refining operation.

Having carburized the articles, they now require hardening, and this hardening operation requires all the possible skill available in the operator. It will be clear from previous discussion that when the carburized articles attain a temperature of 730-740 deg. C. the whole of the case, but only the pearlite areas of the core, become solid solution, *i.e.*, capable of producing the hardened condition of steel. It will thus appear that there is a theoretical temperature which, if attained throughout the article, would give a hardened case with a minimum section of area of hardened material in the core; if this temperature is exceeded, the solid solution areas in the core grow progressively in size owing to the gradual solution of the ferrite into the already existing solid solution areas, and at a temperature of a little over 800 deg. C. the whole of the core will have again become a homogeneous solid solution capable of being hardened. It will be obvious from this that the core may be trapped by quenching in very different conditions; it may consist either, with lower quenching temperatures, of a matrix of soft ferrite with hardened steel "inclusions" imbedded in it, or of a matrix of hardened steel with soft iron "inclusions." The fracture, and, incidentally, the mechanical properties of the core, will vary widely with the quenching temperature, and once you have decided the kind of core you want, only the most careful workmanship, coupled with an appreciation of the underlying principles, can systematically produce the required result.

Before leaving this part of the subject it would be well to emphasize that there is a danger in too low quenching temperatures. One of the great troubles of people who practise the case-hardening process is the appearance of "soft spots." One of the most definite and obvious explanations of "soft spots" is that the material has been quenched at so low a temperature that at certain centers during the quenching operation the breaking down of the solid solution is permitted to occur. When this happens, if the case-hardened article is etched, the "soft spots" will be definitely shown up as dark etching areas.

Case-Hardened Gears, Etc.

While dealing with case-hardening, it would perhaps be well to make a few comments on gear wheels, etc.; the stresses in such parts are of interest. The teeth are submitted to (*a*) a bending action, producing direct tension and compression; (*b*) local surface pressure and abrasion. The body is submitted essentially to torsion, which produces shear. The loads to which the gear is submitted are all fluctuating and frequently applied with shock. The respective merits of soft and tough core as against uniform hardness throughout seem to form a perennial subject for discussion, but it would appear that the comparative merits depend essentially on the amount of shock which has to be withstood. If the parts were not submitted to shock and everything ran perfectly smoothly, then it would be clear that the properties required in the material are surface hardness (resistance to wear) and resistance to fluctuating stresses. Such conditions are best fulfilled by uniform hardness. If gears could be perfectly designed and machined, and if they retained their shape absolutely during hardening and there were no change of gear or other sudden applications of load, then shocks would not require to be dealt with. Unfortunately it is impossible to attain these ideal conditions in practice. The slight distortion in the shape of the teeth is sufficient to change smooth running into a series of shocks, particularly while the wheels are new. Now to consider the question as to whether a soft core does help to withstand shocks, it has been suggested that the capacity of the interior for deformation in such a case is not brought into play until the skin has been deformed beyond its elastic limit, *i.e.*, until the part has been ruptured. In the author's opinion this is not a correct view of the case. The core, having a lower elastic limit, reaches that value before the skin becomes permanently deformed. After this point the deformation produced is greater than would be produced in a wheel of uniform hardness, the stresses in the skin still being within the elastic limit. It should also be remembered that the stresses produced in a thin hollow case for a given deformation are less than would be produced by the same amount of deformation in a solid body of the same material and external shape. With a very thin casing the soft interior takes up the bulk of the energy of the shock, and the hard outside takes up the deformation without becoming very severely stressed. This deformation, however, may be of a permanent nature, involving residual stresses within the elastic limit in the casing. It will be clear that this argument points to a soft core as being the best for gears which have to withstand shocks, and the author will be interested to hear the result of other experiences in this matter.

When we come to discuss a case-hardened ball race, we find that we have to consider not so much the question of shock, but the resistance to fluctuating stresses. For this purpose a too soft core would be a disadvantage, and the maintenance of a higher standard of strength should be taken into consideration during manufacture. It might be claimed for a soft core in this case that a slight yielding in the ball would tend to increase the area of contact between the ball and race and so decrease pressure per unit area. It is suggested, however, that slight modification in the design of the ball and race with a view to modifying the relative curvature of the surfaces would give the same results without stressing the material beyond the elastic limit at any point.

Classifications

The war has emphasized the necessity for standardization of materials and parts generally, and particularly does this apply to automobile and aero engineering. Before the war the steels employed were legion, but as the consumer was actually only getting one quality for each purpose little trouble was experienced. The war, however, necessitated such large supplies that he had to obtain his supplies from several sources, and consequently got very different steels for the same purpose, with disadvantages far too apparent to require discussion. The necessity of the engineer understanding the characteristics and possibilities of the steels with which he has to deal has been pointed out, and it will obviously be an advantage to him if the types of steels are limited to a selected number of the most suitable, so that he will be enabled to focus his attention and have a much greater chance of acquiring that necessary intimate knowledge which his work demands. The Institution of Automobile Engineers has a committee, of which the author is a member, which has selected and defined the compositions of a number of suitable steels, and the same committee is now at work thoroughly investigating their properties. The author feels sure the results will be invaluable to the automobile and aeronautical industries.

Bearing upon specifications, the analysis is not all sufficient, and, indeed, satisfactory mechanical proof tests are not in themselves complete, since one of the greatest troubles which engineers have to consider consists in the occasional local unreliability. The whole process of production requires the most careful study and attention, and it is up to the steel maker to see that all the factors entering into the complete reliability of the ultimate product receive the attention which they merit. To begin with, the actual melting and refining operations require complete understanding and control; the actual casting temperature is a vital factor in determining the relative position of unsoundness, etc., in the resulting ingot; the shape of the ingot is also very important. These three items have a great bearing upon reliability and freedom from segregation, which two items are of extreme importance. When we come to the actual working down of the steel, here again the technique is so important that if the steel is placed in indifferent hands the best of material may be rendered indifferent, or, indeed, may be ruined. The speed with which the ingots or blooms are reheated, together with the actual temperature at which the material is soaked before working, is important, and it is not necessary to point out that there are factors in the actual rolling and hammering operations which require detailed experience if those sections of process are to be satisfactorily dealt with. Incidentally, the actual temperature at which the material is finished in the mill or at the hammer has a bearing on the results.

The FORVM

Function of Water in I. C. Engines

By Carl W. Weiss

THE use of steam in internal combustion engines, which has been so successfully applied to the Mietz & Weiss oil engine for many years, is gradually being recognized by the users of automobiles or trucks as effecting a very great saving of gas as well as a very effective preventive of carbon. The fact that the presence of water vapor in the charge has both these desirable results points directly to the introduction of a certain amount of water in the gasoline—that is, an emulsion that should be kept at a fixed and effective ratio.

It has been shown that at compression pressures of 35-40 atmospheres, a mixture of 1 oil to 5 water will ignite, while at the compression pressure of the ordinary gasoline engine, the ratio of 1 to 2 is possible. No experiments have been made, as far as I know, with such emulsions in automobile engines with gasoline as a basis. Several years ago, I experimented with kerosene and fuel oil water emulsion and found that the proposition depended entirely on the maintenance of a perfect emulsion by an automatic apparatus, which had to be operated by the engine. Such complications are, however, prohibitive in automobile engines, and especially, if the desired result can be had by the introduction of steam or water separately. There are now offered in the market, three types of water or steam devices for automobile engines.

1—Water drawn into the inlet manifold above the carbureter, on some of these also introducing a small jet of air to atomize the water as it enters the manifold. Regulation is made from the dashboard.

2—Steam generated by a coil of pipe wound around the exhaust pipe and introduced into the inlet manifold. Regulation is made from the dashboard, or may be automatic.

3—Air drawn through water for the purpose of increasing its moisture contents before entering the inlet manifold. Operation automatic.

Interference with Suction

The objection to the first is the interference with the suction in the manifold, which necessarily affects the delicate operation of the carbureter. The heat of the manifold, being in no case sufficient to evaporate the water, allows drops of water to enter the engine and cause excessive cylinder wear by the destruction of the hard and highly polished surface generally found in well lubricated cylinders.

This grinding effect on the water is caused by the condensation of carbon, and is especially found in cold or well cooled cylinders, whether the water is introduced as a spray or as steam. It should not be overlooked that the introduction of steam into cold cylinders is just as bad as water, as far as cylinder wear is concerned, unless the inner cylinder surfaces are kept above the temperature of condensation, there is bound to be excessive wear, the extra repair cost of which is higher than the gain in fuel economy by the introduction of steam. The maintenance of the jacket water at boiling temperature is, therefore, necessary to prevent condensation and the destruction of the highly polished cylinder surfaces, which is necessary for a minimum wear and perfect lubrication.

The second proposition; evaporating the water by a coil of pipe around the exhaust pipe has not at all sufficient steaming capacity to be considered. Running a car on a cold, foggy evening for an hour, will put more moisture through an engine than such apparatus (as I have examined) can in three months.

The third scheme; the air moisteners are equally inefficient. There is, however, this to be said about these air moisteners. If all the air taken in by the engine is drawn through the water for the purpose of cooling and cleaning it, the humidity of the air will also be at a saturation point, and if used in engines with non-condensing temperatures, will be of decided advantage.

I understand that devices of this kind have been tested out on tractor engines with excellent results. The tractor engines, unless they use some kind of air filter, will likely inhale an enormous amount of dust and dirt, which naturally, would soon accumulate in the engine and seriously interfere with its operation.

In these tractor engines, equipped with a kerosene burning attachment, there are also provided means for introducing water in the kerosene vaporizer for the purpose of maintaining the most desirable temperature of the vaporizer walls, to prevent the carbonization of the engine and to reduce the oil consumption to a minimum.

Adjusting Water Injection

It has not, however, been possible so far, to adjust the water injection in connection with these kerosene vaporizers automatically, and it appears that this is one of the greatest difficulties which present themselves in the application of kerosene vaporizers, either of the carbureter type, or the introduction of the kerosene direct into the hot air jacketed part of the exhaust manifold.

The best results with the use of steam in the charge of internal combustion engines as to economy, preventing carbon deposits, and at the same time, keeping the cylinders in ideal condition are therefore, to be obtained under the following conditions:

1—Ratio—Gas 1—Water 2.

2—Temperature of water in jacket, boiling or just short of boiling.

3—Steam taken from jacket of cylinder, or if not sufficient steam can be had from this source on account of the effective water cooling by the fan, the exhaust manifold must be water jacketed, so as to present sufficient heating surface to steam the required amount of water.

4—The steam must be taken into the carbureter in order to form an intimate mixture with the air and gas before it enters the engine.

The application of steam in engines on the cars in use to-day, should be limited to those in which the thermo-syphon for the cooling of water is used. The only available, though not quite sufficient, surface for steaming is the exhaust manifold, unless there can be substituted a new water jacketed manifold with sufficient space for the necessary quantity of water, or independent water tank, and a specially designed water jacket or tank should be fitted in each case, suitable for the particular exhaust manifold of the various makes of engines.

Tractor of the Future Will Be Steam

By C. A. Obermaier, M. E.

ATTENDANCE at the national tractor demonstrations this year at Fremont, Neb., was very small, compared with last year. The manufacturers no doubt expected a larger crowd of farmers this year and were therefore somewhat disappointed. It seems that interest in the tractor question has somewhat diminished. The fact of the matter is, the farmer, being more or less motor-wise, knows only too well that the tractor of to-morrow will be much better than the one of to-day. He is conservative and adopts a policy of watchful waiting.

The early types of heavy steam and oil tractors were not very interesting to the multitude of farmers. They have been looking towards the day of the small, reliable and low-priced tractor. The tiller of the soil has seen, inside of 10 years, the automobile developed from a high-priced, unre-

liable piece of machinery, which was used only as a luxury by the idle rich, to a useful, reliable, low-priced vehicle, used by everybody. While at the beginning no farmer would have thought of replacing his faithful horses with an automobile, to-day he uses it universally and could not get along without it. In other words, the farmer is convinced about the practicability and usefulness of the automobile. The same can be said of the truck. Automobile days are here to stay. Tractor days are coming and millions of large and small farmers, not only in the United States of America, but all over the world, are looking with eager eyes towards that day. But that day, while near, is not here as yet.

Many Experiments Necessary

Manufacturers have rushed into the business of making tractors; for some time it was only a question of getting the tractors as quickly as possible to the market, regardless of whether the tractor was right or wrong. Such a policy cannot be good. The wise ones kept back, changed, re-designed and brought out a more perfected product, much to their credit. Some manufacturers have not yet come out and no doubt are working hard to find the right solution. There are many hard nuts to crack and we cannot expect to develop a new industry in record time. We are looking for leaders. Much experimental work has to be done, which is costly, and no doubt some of the wealthier firms will have to blast the way.

The Ford tractor, which created so much interest in last year's show, was absent this year. No doubt extensive changes in the design had to be made. The whole world is waiting for the appearance of the final Ford tractor. Will it be up to expectations?

The tractor industry, being entirely new, gives all manufacturers equal chances to get into the game. So far nobody is very much ahead of the other fellow and merit only will show. In my opinion, those firms who abstain from selling tractors until their product is more perfected will be the gainers in the long run. It does not pay to sell a tractor which is not up to claims. A buyer of such a tractor will never be a booster. It is interesting to see the many different types of tractors, but all seem to use gasoline, kerosene, distillate or alcohol as fuel. None of the seventy-one tractor manufacturers thought of using steam as a power agent. The ideal tractor, in my opinion, seems to be the steam tractor. By using crude oil or kerosene under a tubular boiler the highest degree of efficiency could be attained, a degree that by far could not be approached by the present or even future gas-driven tractor. The most efficient modern heavy truck engine which seems to be the ideal of so many tractor engineers is at the best very wasteful and inefficient, as everybody knows.

Combustion Only Partial

The combustion is only partial, while the combustion of fuel oil or kerosene under a steam generator is almost perfect.

In a gasoline engine the unburnt gases which escape through the exhaust and the heat that has to be eliminated by the radiator are total losses. On the other hand, in a steam engine, the exhaust steam is condensed and fed to the boiler again, so there is hardly any loss. For the modern automobile we need speeds of from 5 to 50 m.p.h., which is equal to a ratio of about 1 to 4, while for the tractor we need only 2 to 2½ m.p.h., making a ratio of about 1 to 80 necessary. The reduction of such abnormal high ratios can only be accomplished with a series of gears which absorb in some cases as much as 50 per cent of the engine's power.

This proves that the slow-going steam engine should be the one best suited for tractor work. The steam tractor would not need to have a transmission, magneto, carbureter, muffler and other troublesome devices. I cannot see how a farmer could start his gas tractor which has been lying idle under an open shed all winter. Hand cranking on a cold spring morning seems to be out of the question. A self-starter otherwise would make things too complicated and costly.

On the other hand, a steam tractor is ready to go as soon as steam is generated, and that is in a few minutes. The difficulty of making a compact boiler of small dimensions, high efficiency and large steam generating capacity has been overcome with the introduction of acetylene and electric welding. The gas tractor works at its best at maximum speed, with no provision for reserve power, while the steam engine works its best at any speed and is capable of developing 30 per cent above its rating. Gas power is erratic and fast, while steam power is constant, slow and powerful. While the former is very wasteful with oil, the latter needs very little. The difficulties a farmer would have with carburetion and ignition are enormous, especially when using kerosene or other low-grade fuels.

A multiple-cylinder gasoline engine seems to be too complicated, nervous and sensitive a piece of machinery for a tractor, while a steam engine no doubt is better suited for such work on account of its simplicity, flexibility and power. The difference in price between a barrel of gasoline and kerosene is quite large at present and will be more so in future.

If we compare the following list of parts of a gasoline and a steam engine power plant for a tractor we can readily see that the cost of a steam tractor should be somewhat less than that of a gasoline tractor.

Gasoline Tractor	Steam Tractor
4-cylinder engine	2-cylinder engine
magneto	steam generator
carbureter	radiator condenser
air washer	fuel tank
gas tank	water tank
radiator	
electric self-starter	
spark distributer and coil	
clutch	
transmission	
electric wiring	
storage battery	
muffler	
electric generator	

Therefore it seems reasonable to claim that the slow-going, high-efficiency simple steam engine of modern design, in combination with a high-pressure steam generator and condenser, should be the proper power plant for a slow-going, hard-working tractor and should be far superior to the modern, high-speed, multiple-cylinder combustion engine.

No doubt the future will prove this claim to be true.

Lowering the Grade of Gasoline

By L. A. Wilson

AFTER reading your editorial of Aug. 30 entitled Lowering the Grade of Gasoline, it occurred to me that you might be interested in the results of a test made by me last week with a device adapted to the utilization of kerosene for automobile fuel. I believe that it has generally been found that the consumption of fuel is, as you state in your editorial, usually greater where kerosene is used in place of gasoline, but I found the contrary to be the case in this test. A regular Ford engine was used, direct-connected to a Sprague electric dynamometer for absorbing and regulating the power. The speed was 1000 r.p.m. and the load corresponded to about one-third opening of throttle. Thirty-minute runs were made, after enough preliminary heating to establish constant conditions. In both cases the carbureters were adjusted down to the point where further decrease in fuel would have resulted in noticeable decrease in power, and this point, I believe, is about right for economy. During the 30-min. interval the engine consumed 5.34 lb. of gasoline. For an equal interval, and at the same load and speed, 3.65 lb. of kerosene was consumed.

Car Started Easily

I did not have an opportunity to make further tests to determine the comparative flexibility of the engine in the two cases, but after the device had been re-installed on the Ford car I witnessed the start, and the car seemed to get away fully as well as a Ford usually does on gasoline. Of course, it was necessary to prime the engine to start it, and the engine acted a little sluggish until the vaporizer became heated. That took only a few seconds, however.

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The Labor Shortage Problem

AT the present time labor conditions are very different from what they were several years ago and they are bound to become worse as long as the war lasts. There are a number of reasons for the present scarcity of labor. Immigration has dropped off to a small fraction of its former volume, mainly owing to the war, but also partly owing to the literacy test law. The enormous quantities of material required directly and indirectly in making war have caused all the establishments producing such materials to be overwhelmed with work; and finally, hundreds of thousands of the active young workers have been withdrawn from productive work by conscription. Eventually there may be a certain compensation in the release of workers employed in the production of non-essentials, but this has not yet become a factor.

Must Increase Efficiency

As a consequence of the conditions outlined there is a very keen competition for all classes of labor and especially for skilled labor. The available supply of such labor cannot be materially increased within a short period and the only alternative to increase production seems to lie in making each operative produce more. The most apparent means to this end is to increase the hours of labor either by increasing the length of the working day or by letting the men work overtime. That the results from this plan rarely come up to expectations is the conclusion arrived at in an article in the current issue of *System* by Prof. Ralph E. Heilman.

Tests conducted in England by various independent committees, among munitions workers and workers preparing and wrapping lint and surgical dressings, showed that when the weekly working hours are unduly increased over the normal standard in peace times the health of the employees suffers, their absence from work on account of sickness is increased, and the production is not materially increased and may be even decreased, owing to excessive fatigue.

Long Overtime Disadvantageous

Long overtime has been found especially disadvantageous from the standpoint of employers, for the reason that for the work done during these extra hours, the period of greatest fatigue and lowest rate of production, the employer is usually required to pay at a higher rate of wages.

Increasing the working hours, therefore, will not solve the problem of labor shortage; it will prove at best a weak palliative. Better results have been obtained in England by the extensive employment of women in industrial establishments and by the so-called dilution of labor.

Better Seat Cushions

BAD roads plus bad seat springs are like diving into a shallow pool. You touch bottom with a rather jarring effect. Upholstery springs which allow you to bring up solidly against the seat support every time the rear wheels strike an obstruction in the road are something which should not be found on a car selling at more than $750, even in these days of scarce and high-priced materials.

The wire coil spring used on a great many of the cars have a tendency to become distorted and tilted so that they entangle with one another. They become loose and often break and altogether give an uncomfortable seat. It is simply a question of getting by with a cheaper product and in these days of price competition it is not hard to see why they are used.

Owner Wants Comfort

On the other hand, there is another side to the story. The user of the car looks for nothing more than he does ease of riding. It is of far greater importance to him than it is to have a mile or two more an hour of speed, as is well evidenced by the thousands of dollars spent every year in the accessory stores for devices intended to better the riding qualities of the car. This should be given as much attention by the man who takes care of the upholstery end of the car as it is by the spring engineer. The latter has been increasing the money put into springs every year by increasing the length and quality of material. The upholstery springs are almost as important as the chassis springs, and if it is well worth while to improve in one direction, it certainly should

be in the other. The upholstery springs like the chassis springs should be the best that the manufacturer can afford.

Closed Car Construction

THIS is the season when the closed car looms up very large on the horizon. This year will probably be the best closed car year that we have yet had. The sedan, brougham, coupe and limousine are going to sell in great quantities. The performance of closed cars this year, therefore, will be watched very closely by a growing number of people.

Rattles are annoying. The best car in the world seems no better than the worst if the driver is annoyed by rattling parts. The tops of the windows, the demountable pillars or stanchions of the sedan, the windshield and the other jointed parts are all susceptible unless infinite care is used to insulate metal from metal. Rumbles given by drum-like surface unstiffened or unbroken against vibration and chassis sounds are always magnified by the closed car.

Price Is Important

Naturally the questions of price and great care are not always easy to compromise, but on the other hand it is always possible to sell a better product at a slightly greater cost, and it is well worth while to do so in the closed body field if the owner is provided a really rattle-proof vehicle. It must be admitted that certain convertible closed types of the sedan style have been great offenders in this during the last three years and the time has come when the public is demanding better workmanship in cars of this kind. Buyers are asking searching questions regarding the precautions taken against rattle and to deceive them in this respect is a policy which will cost the industry more than it can afford to lose.

Steel Wheels

IT is a rather remarkable fact that there is not as yet any agreement as to the ideal wheel for motor trucks. The wood wheel is only satisfactory within limits; it is heavy and it is not everlasting. The cast-steel wheel has proved so tough a foundry proposition that the source of supply is limited; few steel-casting manufacturers care to take it up. Most of the pressed-steel wheels are so designed that they are very expensive to make and require a great length of welding which needs skilled workmanship, and thus acts against rapid production.

The cast-aluminum wheel has been tried. It is easy to cast because it can be thick walled, and it is light, but it was only tried just as the price of aluminum began to soar. The wire wheel was tried, and proved very successful in experimental service, but appearance was against it. It was impossible to believe that so spidery looking a wheel could possibly be strong enough; also it was highly costly.

Of all constructions, the disk wheel seems the most promising. The possibilities of disk construction are not yet grasped, but many inventors are busy upon wheels of this sort. The simplest (wheels made from but a single thickness of sheet steel pressed into a saucer shape) are being used with great success both in America and Europe, while there are many more scientific designs with two disks, lighter and not too hard to make. The weight of truck wheels is out of all proportion to the rest of the chassis. Being unsprung, it is destructive weight, damaging to the road and to the tire. Any design that promises adequate strength with diminished weight ought to be encouraged to the full.

Safety Engineering

ENGINEERING is constantly developing and new branches spring up right along. It is only a few years ago that we first heard of efficiency engineering, and lately another branch has been added to the domain of engineering, that of the safety engineer.

The development of safety engineering has been more or less concurrent with the spread of the "Safety First" movement. Various developments in methods employed in factories in recent years have tended to increase the number of industrial accidents. The constant speeding up of machinery, in part the result of the introduction of high-speed steel, the overtime and night work made necessary by war requirements and the almost exclusive use of power for conveying materials and products in the factory, have increased the hazards surrounding the factory worker.

Skilled Labor Is Scarce

Quite recently the scarcity of skilled labor had added further to the risks of accidents in industrial establishments. In many cases it has been found necessary to take unskilled labor and train it in the operation of the different machines. These men, not realizing the risks they run, are careless, and, as a result, the accident rate increases rapidly.

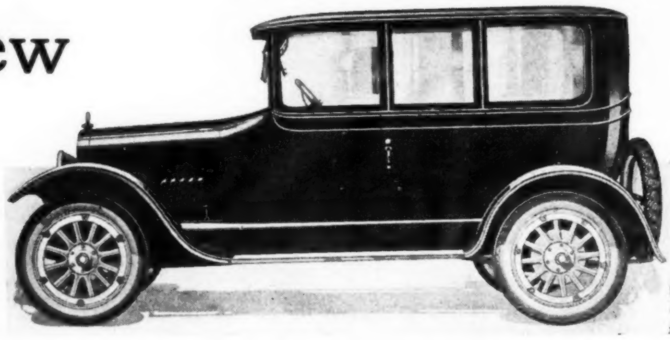
Much has been done to reduce the danger of various machine tools, and improved safety devices are constantly being perfected. Where a machine is constantly used for the same work it is generally not difficult to surround it with safeguards that make accidents all but impossible, but a much more difficult problem arises if the machine is used on variety work. This applies particularly to circular saws.

Exchanging Experiences

By meeting together once a year and exchanging experiences, as safety engineers and insurance men did at New York last week, progress in devices and methods for insuring the health and safety of industrial workers can be accelerated. At this meeting a laudable spirit of give and take prevailed, every delegate whose firm had satisfactorily solved some problem having to do with the safety of the workers seeming to be willing and even eager to inform his conferees about it. A few years more of this excellent work should help to greatly reduce the proportion of factory workers that are crippled or killed in accidents in the course of a year.

Abbott 1918 Line New

One Chassis Model Fitted with Four Different Body Types — Chassis Assembled of Standard Parts



Abbott five passenger sedan

THE 1918 line of the Abbott Corp., Cleveland, is now ready and shipments have commenced. The chassis is entirely a new job, and the line consists of four body types, including a seven-passenger touring and a four-passenger, at $1,595, and a four-passenger coupé and five-passenger sedan, at $2,150. These bodies are also new and the line is thoroughly up to date, with improved units throughout.

The Abbott chassis is assembled from the products of well-known parts manufacturers. The engine is the 7 N Continental, 3½ by 5¼ in., with three-point suspension of the unit powerplant. This is a block cast job and has separately cast water jacket heads, thus insuring maximum uniformity in cylinder castings.

Lubrication is by a combination force feed and splash system operated by a horizontal plunger pump driven by an eccentric from the camshaft. This forces the oil through copper tubes directly to the timing gears and all the main crank and camshaft bearings, whence it drains back into the oil pan to maintain the constant level for the splash system.

The gasoline system comprises a rear tank and a Stewart vacuum system in connection with a type L B Stromberg horizontal, 1¼ in. carbureter. The Stewart vacuum system is placed on the dash in such a position that there will be sufficient head on the carbureter float chamber to insure continuous feed of gasoline under all conditions.

Starting and lighting is by the double unit system with starting motor mounted on the left side of the engine to engage with the flywheel by means of the Bendix drive. The distributor is mounted on the generator on the right side of the engine, and is driven by the pump shaft. The battery is hung from the frame on pressed steel brackets directly ahead of the front seat and can be taken out by lifting the front seat floor board. This is a 6-volt, ground-return system.

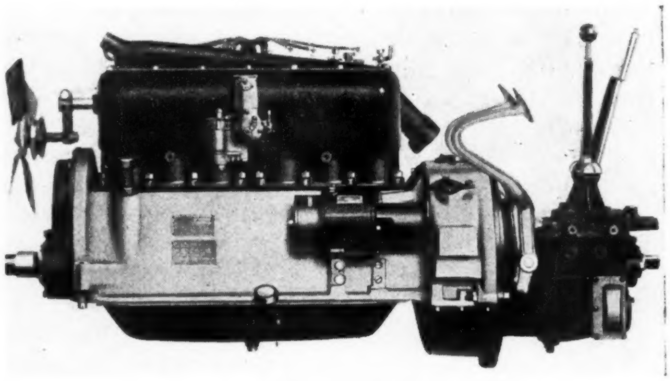
The clutch is a multiple dry disc type, delivering its drive to a three-speed selective gearbox in which the ratios are as follows:

Low, 2.8 to 1; intermediate, 1.77 to 1; reverse, 3.6 to 1 and high, 1 to 1.

The propeller shaft is of seamless nickel steel tubing, with Spicer universal joints at each end, and the universal on the transmission unit has a ten spline slip connection. The one on the axle end has no slip.

A three-quarter floating rear axle is used, equipped with 1⅜ in. nickel steel shafts for both drive shafts and pinion shafts. The brakes are 14 in. by 2 in., internal and external, with the differential and wheels carried on Hyatt high-duty roller bearings.

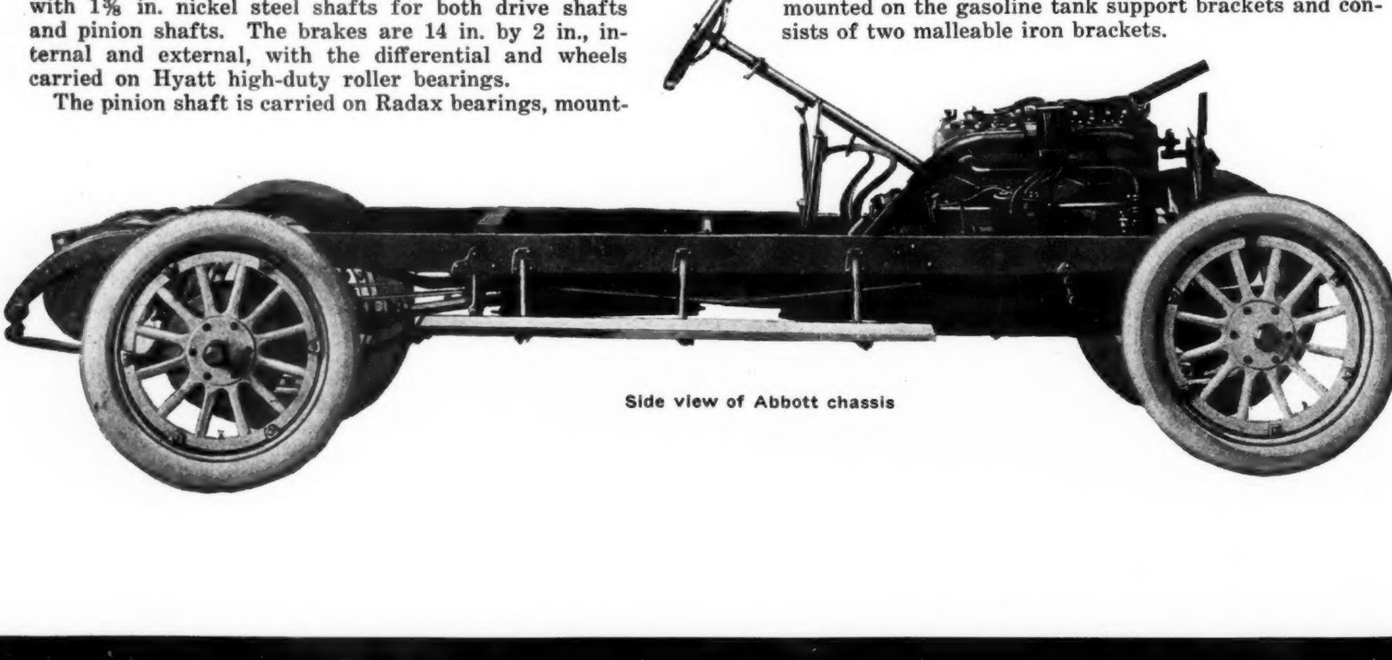
The pinion shaft is carried on Radax bearings, mounted directly back of the pinion, and the spring seats on this axle are mounted solid and are so arranged that the pinion shaft under normal load with the chassis level is in straight line with the propeller shaft. The gear ratio in the rear axle for the roadster and speedster is 4.08 to 1, and in the touring car, coupé and sedan, 4.3 to 1.



The Abbott power plant

Semi-elliptic springs are used both in front and rear. The front springs have nine leaves 2 in. wide and are 38 in. long from eye center to eye center. The rear springs have eleven leaves at the front end and eight at the rear, and are what is known as the Duplex type. The spring dimensions are 2 in. by 55½ in., and ¾ in. spring bolts are used, front and rear. All the spring eyes carry Clemens steel bushings. The drive is of the Hotchkiss type with both torque and propulsion taken through the springs. The front end of the rear springs takes the torque, part of the load and also the drive.

The wheelbase of the chassis is 122 in.; the frame is made of pressed steel channel 4½ in. deep and has a kick-up over the rear axle. The side channels are tapered to support the body sill. The wheels are fitted with 34 by 4 straight side Firestone rims and tires and have 12 spokes, each spoke being 1½ in. in diameter. The tire carrier is mounted on the gasoline tank support brackets and consists of two malleable iron brackets.



Side view of Abbott chassis

News of the Automotive Industries

Business Conditions Puzzling

High-Priced Car Sales Decrease—Large Makers of Cars Under $1,200 Are Prosperous

DETROIT, Sept. 17—Automobile and parts makers are encountering confusing problems which have developed in the past few weeks. High-priced car sales have decreased noticeably. The small companies manufacturing cars are encountering difficulties. Labor is becoming scarce. The large manufacturers of cars selling for less than $1,200 are enjoying the greatest prosperity in their histories, and with this unusual combination of conditions no one knows what to anticipate for the future.

Several large manufacturers of cars, including those who specialize in high-priced cars and those who make a range of cars from low, or medium price to high price, state that orders for the higher-priced cars have fallen off to a considerable extent and they are unable to understand the cause for it. At the same time, many of the small manufacturers of low-priced cars report a slackening of business which they are unable to understand in view of the large business being transacted by the big manufacturers of popular-priced cars. Every plant in this section that has the facilities is now engaging to some extent in munitions manufacture and the consequence is a shortage of labor both skilled and unskilled for the car manufacturers.

The Willys-Overland, Inc., had an increase of 14 per cent in business for the months of July and August of this year as compared with the corresponding period of 1916. All of the General Motors divisions report record breaking business, the Buick division producing 600 cars per day, the Olds Motor Works transacting the largest business in its 20 years of motoring history, while the Oakland and Cadillac divisions are making similar reports.

A large concern engaged in smelting and refining and transacting business with the entire industry reports that it finds business excellent among the large manufacturers of popular-priced cars, but that it is having considerable credit difficulty with many of the smaller concerns and with a large number of parts and accessory makers.

Reports from various sections of the country are exceedingly optimistic. Los Angeles, Cal., experienced the largest month's business in August in the city's history, the sales of new and used cars in Los Angeles County for the month amounting to more than 5000. Spokane, Wash., reports a considerable number of sales for Elgins, Oldsmobiles, Chalmers and Saxons, principally to farmers in nearby localities. Reports from the Southwest are of the same type, Wheeling, W. Va., for instance, reporting that it has enjoyed its busiest month in the last four weeks, which was due to some extent to the State Fair and Exposition.

Tire Makers Not Affected

Tire manufacturers report that business has not been and probably will not be affected by the war, and state that they are operating the full and usual number of employees. Fabric and rubber are both increasing in price, and labor, which has become scarce, is receiving increased wages. Companies are experiencing difficulty in securing rubber because of the withdrawal of Japanese shipping in the Pacific.

FORD TRACTOR PLANT TO COST $20,000,000

DETROIT, Sept. 17—Henry Ford & Son have arranged for the construction of the River Rouge tractor plant and blast furnaces. The cost will be $20,000,000, of which $8,000,000 will be spent for labor.

The plans are in the hands of Henry Ford's architects and engineers. Work will center on the blast furnaces at the start. The tractor plant will be developed later. The steel plant will start with 500 employees; extensive use of automatic machinery will replace manual labor.

One hundred and thirty-four acres have been set aside in the River Rouge tract for the furnaces, coke ovens, docks and other buildings. The furnaces will have a capacity of 1000 tons a day. The loading dock will be 2400 ft. long.

The plant will furnish all the iron and steel used in Ford cars and, it is expected, in the tractors to be built by Henry Ford & Son.

Hugh Chalmers to Manufacture War Materials

DETROIT, Sept. 17—Hugh Chalmers, formerly president, and William P. Kiser, formerly vice-president of the Chalmers Motor Co., have organized the Chalkis Co. and have obtained a plant in this city for the manufacture of war materials. Mr. Chalmers states that as the Chalmers Motor Co. is now an inactive organization and he has resigned the presidency, he will continue as chairman of the board of directors during the lease of the Maxwell company.

Chalmers Officials Resign

Maxwell Assumes Complete Charge—S. E. Hall New President—Morse on Vacation

DETROIT, Sept. 17—The Maxwell Motor Co. to-day assumed complete charge of the Chalmers Motor Co. under the 5-year lease recently arranged and discussed in a previous issue of THE AUTOMOBILE AND AUTOMOTIVE INDUSTRIES. Notices were posted in the plant reading as follows:

NOTICE

The Maxwell Motor Co., Incorporated, has taken a 5-year lease of the Chalmers factories. The following officers of the Maxwell Motor Co. will be in charge of operations of the Chalmers business:

Walter E. Flanders, president and general manager; Walter M. Anthony, comptroller; T. J. Toner, director of sales; Charles Adams, production manager; E. J. Miles, engineer; William Kelly, engineer; R. M. Hood, purchasing agent; Carl H. Pelton, assistant to the president; B. A. Lyman, assistant treasurer; J. H. Johnston, general auditor.

We hope to retain practically all of the present employees of the Chalmers Co., and to increase the working force from time to time as the business grows.

We will announce later the names of the men who will be located at the Chalmers factory in direct charge of the different operating departments.

Maxwell Motor Co., Inc.,
Walter E. Flanders,
President and General Manger.

Following the inactivity of the Chalmers company the executive officers resigned. Hugh Chalmers resigned as president but remained as chairman of the board of directors of the Chalmers company. E. C. Morse, vice-president and director of sales; William P. Kiser, vice-president, assistant general manager and secretary, and David Turnbull, treasurer, have tendered their resignations. The new officers of the company are Sherwood E. Hall, president; W. W. Miller, vice-president; A. Owen, secretary, and John F. Flint, treasurer. With the exception of Mr. Flint the officers are New York attorneys who directed the lease for the Maxwell company. Mr. Flint will be the only active officer of the Chalmers company and will make his headquarters at the plant. Other Chalmers officials who have resigned are: Harry L. Bill, works manager; H. W. Johnson, superintendent of foundries, and C. A. Woodruff, purchasing agent.

Walter E. Flanders is calling a meeting of ten Maxwell zone managers to supervise the distribution of Chalmers cars, and will have fifteen field men of the Chalmers organization at the conference.

Mr. Morse plans to take a vacation for some time following the acceptance of his resignation.

Aircraft Boards See Italian Plane

Carries 20 Passengers and Large Guns—May Be Used In Camps Here

WASHINGTON, Sept. 15—Members of the International Aircraft Standards Board and the Aircraft Production Board spent several days at Newport News, Va., this week in an inspection of different models of Italian planes sent to this country at the suggestion of engineers of the Royal Italian army now here, and co-operating with members of the Aircraft Production Board and the International Board in the development of the U. S. motor and plane.

Great interest is being manifested by American engineers in the huge Italian battle plane sent to this country to be used as a model in instructing them along the lines of the building of practical airplanes for war purposes. This giant plane was sent here dismantled and assembled after arrival. It has a carrying capacity of twenty, in addition to its guns of large size, and its type has been used with distinct success in the field.

It is not considered probable, however, that the United States will build many, if any, of this type. If a few are built they doubtless will be used for experimental and instruction purposes in the camps in this country. The planes to be built by this government for service abroad of the scout plane type, with possibly one, two or three guns, because of their size can be shipped abroad much more successfully. Those familiar with the big Italian machine say that its very size would operate to prevent its being sent abroad, as too few of them could be transported.

BRISCOE 1-TON TRUCK $1,000

JACKSON, MICH., Sept. 18—The Briscoe Motor Corp. has a 1-ton truck which is interchangeable in a great many of its parts with the Briscoe Model 24. It lists at $1,000 and is equipped with starter and windshield. The truck has a wheelbase of 132 in. It has a counterbalanced crankshaft, cone type of clutch, transmission in unit with the jackshaft, and chain final drive.

Automotive Committee Reorganized

WASHINGTON, Sept. 19—*Special*—The Committee of Automotive Transport of the Council of National Defense has been completely reorganized and in the future will be known as the Automotive Products Committee of the War Industries Board. The committee is composed of Harry L. Horning, chairman, who will be in charge of tractor and truck organization; Col. Chauncey B. Baker, Quartermaster Corps of the Army, who will be in charge of transportation; Coker F. Clarkson, general manager of the S. A. E., who will have charge of all matters between the S. A. E. and the new committee; Frank W. Russell, representing the Aircraft Manufacturers' Assn.; C. W. Henderson, representing the Motorcycle & Allied Trades Assn.; Henry R. Sutphen, representing the National Boat & Engine Mfrs. Assn., and Hugh Frane, representing the labor organizations. The committee as organized will operate directly under Robert S. Brookings, who is in charge of the finished products of the War Industries Board.

Airplane Co. for Grand Rapids

GRAND RAPIDS, MICH., Sept. 18—Plans are under way for the organization of the Grand Rapids Aeronautic Motors Co. to manufacture airplanes. Designs for the motors manufactured under the Field patents are being completed in Detroit and the plan is to have 100 men subscribe $100 each to the company which will be organized. Fred Z. Pantlind, and L. W. Coppock are interested in the enterprise.

Jobbers Plead Not Guilty to Restraint Action

NEW YORK, Sept. 17—Commissioner William M. Webster and several principles in the National Association of Automobile Accessory Jobbers appeared today in the United States court to plead to the indictment recently returned charging violation of the Sherman antitrust law. Each pleaded not guilty and gave bail of $5,000. The time of trial has not been set.

Twenty-one men in all were indicted. Not all of the twenty-one were in the delegation which came to this city from the convention at French Lick Springs last week. The others will appear within the next few days.

Among those appearing to-day were: President Charles E. Faeth; ex-president, Sidney B. Dean; William K. Norris, Grant F. Discher, George E. Edmunds, Sidney F. Beech, Thomas M. Brooks and Fred Campbell.

Marmon To Build Liberty Engines

INDIANAPOLIS, Sept. 16—The Nordyke & Marmon Co. has been awarded a contract for the construction of airplane engines totalling $2,700,000. The contract calls for the delivery of 3000 engines by June 1, 1918. The company can very easily meet the requirements of the contract with its added manufacturing facilities, an additional plant having been constructed during the last 90 days.

Gasoline Prices Soar in Havana

HAVANA, CUBA, Sept. 18—Retail dealers in gasoline have advanced the price from 47 cents a gal. to $1 and in some instances to $1.20. The East Indies Oil Co. has announced that its supply will last 10 days. About 400,000 gal. is expected to arrive shortly.

J. W. Stoddard Dead

DAYTON, OHIO, Sept. 18—John W. Stoddard, retired president of the Dayton Motor Car Co., is dead at the age of 80. Mr. Stoddard was born in Dayton. He became a manufacturer of automobiles in 1904.

Army Truck Production Organized

Experts Under Girl at Washington—Contracts To Be Let Soon

WASHINGTON, D. C., Sept. 18—*Special Telegram*—Christian Girl, president of the Standard Parts Co. of Cleveland, who came to Washington as director of production at the instance of Colonel Chauncey B. Baker of the Quartermaster Corps of the army, has gathered together a force of experts from factories all over the country, at his headquarters at 1421 I Street, N. W., and has made the following appointments: Frances Kelley, secretary to Mr. Girl; J. G. Utz, supervisor of inspection; Walter S. Quinlan, supervisor of raw material; P. W. Tracy, supervisor of parts plants; John M. McIntosh, assistant supervisor of parts plants; Guy Morgan, plant surveyor; Arthur G. Drefs, supervisor of charts and distribution; James F. Bourquin, supervisor of assembly plants; Stanley H. Wardwell, assistant supervisor of charts and distribution.

All Experts

These men were chosen from different factories on the recommendation of their superiors as being best fitted to aid the Government in its mammoth task of producing the standardized military trucks with the necessary expedition and at the lowest possible cost. Plans for carrying out the work are rapidly being formulated.

Contracts are to be let soon by the Government for materials necessary to carry out the production plans on a very large scale. The co-operation of large producers has already been assured, to the end that there may be no unnecessary delay. Coincident with the letting of these contracts, large manufacturers of trucks will begin preparations for the turning out of certain parts of these trucks. This done, production will soon be on a large scale. Two complete military trucks of the standard design are to be built for the Government by the Gramm-Bernstein Co., Lima, Ohio, and the Selden Motor Truck Corp., Rochester, N. Y. These trucks will be used for experimental purposes.

First Lawson Airplane Tested

GREEN BAY., WIS., Sept. 17—The first complete airplane to be produced by the Lawson Aircraft Corp., Green Bay, Wis., was given its first tests during the last week under the personal direction of Alfred W. Lawson, vice president and general manager of the company. The machine is a military tractor biplane and construction work was started May 10. Lawson took the machine into the air at the testing field near Green Bay and on the first trial remained in the air more than fifteen minutes, being able to speed the machine up to 75 m. h. p., at an altitude of from 600 to 1000 ft.

Automobile Exports Drop

July Figures Show Increase in Trucks—$2,130,648 Decrease from June

Mos.	Cars	Value	Trucks	Value	Parts
1917					
July..	5081	$3,621,539	1386	$3,561,583	$2,139,938
June..	7609	5,721,494	1245	2,965,254	2,766,960
1916					
July..	5258	3,663,563	1243	3,062,670	1,630,111

WASHINGTON, Sept. 14—A drop of 33 per cent in automobile exports occurred in July, according to the latest figures. Truck exports, on the other hand, showed a gain. Automobile shipments in July totalled 5081, valued at $3,621,539, as against 7609 in June, valued at $5,721,494, and 5258 in July, 1916, valued at $3,663,563. Truck exports in July totalled 1386, valued at $3,561,583, as against 1245 in June, valued at $2,965,254, and 1243 in July, 1916, valued at $3,062,670.

Our biggest purchaser of automobiles in July was Canada, which bought 1373 cars valued at $886,603. Very few cars went to France, Norway, Russia, Australia and the Philippine Islands, their purchases in each instance not numbering over fifty. Denmark did not get one car into her ports in July. Argentina bought 350, Chile 431 and Cuba 189. British South Africa, which has for the past few months been a consistent purchaser of American cars, took 301.

None of our sales of trucks to foreign countries exceeded 831 in any instance in July. The United Kingdom, which has been buying lately a large number of trucks, took the above number. France purchased 382 and Canada took 59. Russia did not purchase a single one of our trucks.

For the 7 months ending July, exports of automobiles, trucks and parts were valued at $68,330,576, compared with $69,698,691 in the corresponding period in 1916. Of this amount in 1917, 8572 trucks valued at $20,620,076 and 41,143 cars valued at $30,752,081 and $16,958,419 in parts were exported.

Canada has been our biggest purchaser of cars this year, her purchases numbering 11,753, valued at $8,890,059. None of the other countries have taken over 2750 this year. Only 169 have been taken by Russia, our smallest buyer. On the other hand, the South American countries have made substantial purchases. Argentina took 2065, valued at $1,347,339, and Chile 2030, valued at $1,487,571.

Our largest purchaser of trucks during the 7 months of 1917 was the United Kingdom, which was shipped 4648 trucks valued at $12,095,848. France was second with 1677, valued at $4,533,672. Canada took 479 and Russia 515.

—

$21,750,000 for Armored Cars

WASHINGTON, Sept. 17—The House of Representatives has sent to the Senate its deficiency bill, authorizing $16,750,000 for armored cars with authority to contract for $5,000,000 more. $350,000,000 is appropriated for the transportation of the army and its supplies; $3,000,000 for the signal service; $12,000,000 for roads, walks, wharves and drainage at military camps, and $170,277,000 for automatic machine rifles. These items for the army use, of course, are in addition to the $640,000,000 appropriated in the regular bill for aviation purposes. The deficiency bill also carries $35,000,000 for aviation in the navy.

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Large Machine Tool Order for France

NEW YORK, Sept. 18—J. G. White & Co., a New York firm of consulting engineers, has asked for bids on machine tools to the value of several million dollars. These tools are wanted by the Government and are to be shipped to France, where they are to form the equipment of an airplane engine factory. Deliveries are called for within 30 days on much of the equipment.

Trucks for Parcel Post Service

P. O. Department to Experiment Near Large Cities—Would Reach Farms

WASHINGTON, Sept. 18—The Postmaster General has issued a statement strongly supporting the Moon house bill authorizing experiments by the Postoffice Department in the operation of motor trucks in the vicinity of large cities. In the view of the Postmaster General the operation of these motor truck routes would add 100 per cent to the value of the parcel post service.

The real purpose of the Moon bill is to co-ordinate with the parcel post system the benefits of the millions of dollars already expended and to be expended in the development of motor vehicles and the making of good roads.

It is pointed out by Postmaster General Burleson that about many of the larger cities of the country especially, Pittsburgh being suggested as an illustration, within a radius of 50 miles there are to be found productive districts occupied by farms and villages which are without direct postal facilities. These would be reached by the contemplated motor truck routes to the convenience and advantage of both the isolated communities and of the consumers in the cities.

The carrying out of this plan would call for the purchase by the Government of large numbers of motor trucks in addition to those already in the service of the postal department, and would stimulate good roads and living conditions generally in the widely scattered areas in which the motor routes would be established.

Many large cities to-day have no rural routes emanating from them, it is pointed out, such routes having in the past been confined almost exclusively to the smaller towns or cities.

Exports of Automobiles, Trucks and Parts for July and Six Previous Months

	July				Six Previous Months			
	1916		1917		1916		1917	
	No.	Value	No.	Value	No.	Value	No.	Value
Passenger cars	5,258	$3,663,563	5,081	$3,621,539	38,407	$25,897,743	41,143	$30,752,081
Commercial cars	1,243	3,062,670	1,386	3,561,583	11,373	30,725,682	8,572	20,620,076
Parts, not including engines and tires	....	1,630,111	....	2,139,938	.....	13,175,266	.....	16,958,419
Total	6,501	$8,356,344	6,467	$9,323,050	49,780	$69,798,691	49,715	$68,330,576

By Countries for 1917

	Passenger Cars		Commercial Cars		Passenger Cars		Commercial Cars	
Denmark	....	....	...	....	247	$223,616	.....	....
France	49	$24,378	382	$1,129,743	1,025	534,787	1,677	$4,533,672
Norway	37	40,395	...	....	627	672,418	.....	....
Russia in Europe	22	11,200	...	....	168	218,445	322	819,325
United Kingdom	121	171,150	831	2,171,317	850	923,546	4,648	12,095,848
Canada	1,373	886,603	59	85,435	11,753	8,890,059	479	635,964
Cuba	189	172,245	...	....	1,303	1,166,310	.....	....
Argentina	350	241,084	...	....	2,065	1,347,339	.....	....
Chile	431	277,599	...	....	2,030	1,487,571	.....	....
British India	14	14,299	...	....	1,495	1,153,527	.....	....
Dutch East Indies	64	83,539	...	....	1,247	1,203,734	.....	....
Russia in Asia	....	....	...	....	255	411,038	193	622,883
Australia	167	124,226	...	....	2,681	2,064,939	.....	....
New Zealand	143	102,848	...	....	1,857	1,351,513	.....	....
Philippine Islands	30	26,563	...	....	646	459,176	.....	....
British South Africa	301	244,073	...	....	2,219	1,569,955	.....	....
Other Countries	1,790	1,201,337	114	175,088	10,675	7,074,108	1,253	1,912,384
	5,081	$3,621,539	1,386	$3,561,583	41,143	$29,264,510	8,572	$20,620,076

Industrial Review of the Week

A Summary of Major Developments in Other Fields

NEW YORK, Sept. 19—Every nerve is being strained in the big industrial fields of the country to cope with Government demands and to produce at prices set by the Federal authorities. The result is that the ordinary lines of commercial work are suffering. Soft coal at $2 a ton is not being moved rapidly, because many mines are not able to produce at that figure. The result is that a number of plants are shutting down which could otherwise be doing a profitable business at this time. The railroads are moving freight cars to the South to take care of the demands for shipping lumber, grain, melons, vegetables and other products to the markets. Iron and steel prices have been falling during the past week, whereas the tendency in wages is upward. The holidays of the week have resulted in a quiet textile market with prices a trifle firmer on cotton goods.

A New Service

¶ *Herewith* THE AUTOMOBILE AND AUTOMOTIVE INDUSTRIES *supplies for the benefit of its readers a general summary of important developments in other fields of business. This is rendered possible by the editorial cooperation of leading industrial publications which are recognized authorities.*

By compressing the general industrial situation into this form we hope to give our readers a clear and comprehensive idea of up-to-the-minute developments which they could otherwise secure only with considerable expenditure of time and effort.

Slump in Metal Market

The pig-iron market is usually made by resale transactions, chiefly of iron intended for export, but there are evidences of weakening in furnace prices. In foundry iron the most marked recession is in connection with Eastern sales. Generally the market may be put at $2 below last week's level. In basic iron the break is a reminder of the rapid advances of a few months ago. A Shenango valley steel interest has sold 2000 tons from an accumulation for prompt shipment at $42 at furnace, against $48 ruling a week ago. In face of this, quotations as high as $50 are still made. As iron and steel prices fall the course of wages is upward and still upward.

It is becoming clearer that recent contracting at concessions from the lately firm levels is to fix with a certainty the supply of material. Consumers may believe that the quantities available at Government prices after Government needs, general contracts, and spot demands are cared for will be small.—*Iron Age.*

Steel Ship Contract Awarded

A contract has been awarded to the Submarine Boat Corp. for fifty steel ships of 5000 tons each. It is said that the contract will be followed soon by another for 150 ships. This work will necessitate the building of one of the largest shipbuilding plants of the United States at Newark Bay opposite Bayonne, New Jersey. The site for the plant covers 125 acres of ground with 1000 feet of water front, material to build the shops has been contracted for, and the work of erection will start at once. It is planned to lay the keels of the first vessels in December, the first launching will be in February, and when the work has been speeded up the deliveries will be made at the rate of one vessel every two days. The ships will be 350 ft. long, 46 ft. beam, and 27 ft. molded depth. To carry out this work, employment will be given to about 12,000 men.—*F. W. Dodge. Construction Reports.*

Clean-Up Details of Standard Truck

(*Continued from page* 487)

The flywheel itself is exceptionally large, being 20 in. diameter and 4 in. wide on the rim, the weight being 130 lb.

The cast-iron pistons are fairly heavy, 6⅛ in. long and with three rings and a 1⅜ hollow wrist pin locked in the piston. The pin center is 2⅝ in. from the bottom of the piston. Ten thousandths clearance at the top and over the upper ring land is called for and four-thousandths on the lower ring land and the rest of the skirt.

The manifolding system is designed to take care of heavy gasoline, and is regarded as the most experimental thing about the engine. The exhaust manifold is conventional, except that at the center it has a rectangular opening. The intake ports are below the level of the exhaust ports, so that the intake manifold flanges can be attached, and the intake manifold branches come out and up in an easy sweep. Where they join there is a rectangular face matching the one on the exhaust manifold, and a sort of box like a muff on the intake. These two faces bolt together, with a gasket, thus allowing the exhaust to play upon the point where the two branches of the intake connect with the short vertical part containing the governor throttle and ending in the carbureter flange. The carbureter is set quite high and will, of course, be a vertical model, though the make is entirely undecided and will in fact be settled by trial only.

The rest of the chassis has been described in more detail before. Concerning the multiple dry disk clutch there is little to be said, except that the throwout bearing is much above the average size. The gearset with its four speeds and the two shafts in the same horizontal plane is much as it was first sketched out. It is an excellent manufacturing proposition and will weigh about 300 lb. A short shaft links it to the clutch via two metal universal joints.

The transmission is rather ingeniously hung. At the rear are two lugs drilled to receive pins on a transverse axis, and these pins also pass through the ends of a pair of brackets hanging from a plain pressed steel cross member. The front end of the case has a "nose" surrounding the bearings of the main shaft, and this nose is held up to a bracket hung from another cross member by a cap like a bearing cap. The cap does not grip the case tightly so as to allow a certain amount of floating fore and aft movement.

This suspension makes it very easy to remove the case, since it is only necessary to remove the cap and knock out the two pins at the rear after disconnecting the pins in the three gear striker rods and disconnecting a universal joint in front, the slip joint takes care of the universal on the propeller shaft.

The last mentioned is normally almost horizontal, in a practically perfect position for the Hotchkiss drive.

The axle, though it contains much that is new, is mainly Timken in exterior. It is a full floating pattern with a pressed steel case and has taper roller bearings all through, even on the worm shaft. As stated before, both sets of brakes are expanding, side by side in the same drums. These brakes are of the band type and are provided with adjustment for setting the concentricity of the bands. In laying out the brake connections great care has been taken to plot the paths of the brake lever eyes as the spring deflects, and the cross shafts, of which there are two, are placed so that axle movement will have a minimum of effect upon the brakes. To compensate for torsional deformation of the spring the axle brake levers are carried up till the eyes are nearly in line with the top plate of the spring, thus resulting in spring deformation causing an up and down movement of the levers instead of a horizontal one, and the vertical movement does not affect the tension on the brake rods.

$1,313,668 Gain for Saxon

Cash Balance Increased Since June 30 to $437,490—Contracts for 30,000 Cars

NEW YORK, Sept. 18—Plans for financing the Saxon Motor Corp. will be acted upon by the board of directors. It was announced at the stockholders' meeting held here to-day that the financial position of the company has improved since the creditors' advisory committee proffered its aid. Working in co-operation with the creditors' advisory committee the company has made a net financial gain of $1,313,068 since June 30, the end of the fiscal year. The cash balance has been raised from $196,825 to $437,490 as of Sept. 14, an increase of $240,665. Collection drafts have increased $305,792 and discount drafts have decreased $854,583.

As an evidence of the progress in the production and sale of Saxon cars, orders at the factory have increased steadily since June, the July orders totalling 791 cars; August, 1365 cars, and September, for half of the month, 1027 cars, an average of 114 cars per day.

The shipments have gone from 508 cars in June to 792 cars in July, 1223 cars in August and will probably approximate from 1800 to 2000 cars for September. Contracts in hand amount to more than 30,000 cars.

The new financing plan will be formulated mainly for the purpose of taking care of the construction of the new factory at Detroit which is being completed now.

Directors elected were Benjamin Gotfredson, a Detroit capitalist and president of the American Auto Trimming Co. and a large stockholder in the Saxon Company from its formation; Harry W. Ford, Detroit; Lee Counselman, New York; E. C. Lynch and H. D. Williams of Merrill, Lynch & Co., New York; Bernard Strauss, of M. Strauss & Sons, leather manufacturers, Newark, N. J.; Harry Harper, president, Prudden Wheel Co., Lansing, Mich. Officers: Harry W. Ford, president; Lee Counselman, vice-president; Benjamin Gotfredson, secretary and treasurer.

$500,000 Plant for U. S. Airplane

BRIDGEPORT, CONN., Sept. 19—The U. S. Airplane Corp., capitalized at $5,000,000 and formed last May, has bought 14 acres in Stratford, Conn., to erect a plant to cost $500,000 with hangars and classrooms. The company will also conduct a navy flying course as used at the Yale flying school. The whole plant is to be finished in November. A new type of engine will be used, the details of which are withheld at present.

Falls Engines for Curtiss

SHEBOYGAN FALLS, WIS., Sept. 17—The Falls Motors Corp., Sheboygan Falls, Wis., has taken a large order for motors and engine parts for the Curtiss Airplane Corp., and shipments will begin about Sept. 22. The initial order calls for 5000 engines.

Lexington-Howard Reorganized

CONNERSVILLE, IND., Sept. 14—The Lexington-Howard Co. has been reorganized by the incorporation of the Lexington Motor Co., capitalized at $1,800,000. Of this, $1,200,000 is in preferred.

Stock Prices Continue Decline

Few Gains Made in Automotive Issues—Portage Rubber Down 15 Points

NEW YORK, Sept. 19—Automotive stocks continued their decline started about a month ago, some of the stocks making new low marks. The declines have had a sympathetic effect on the market position of the companies' preferred stocks, even though these issues appear to be strongly protected both as to assets and earning power. General Motors preferred, Willys-Overland preferred and Maxwell first preferred are all selling about 10 points under the high of this year, and Studebaker preferred about 18 points under the 1917 top. At the present levels the income return from these listed motor preferred stocks is about 7½ per cent for General Motors, Willys and Studebaker issues, and just under 11 per cent for the first preferred issue of Maxwell.

The tire issues, which were weak last week, are also well protected. Though tire prices have gone up, the companies have nothing to complain of, except as to the high cost of fabric. The war has not hurt the sales of tires and the factories are working at full blast.

Bear raids have been the main reason for declines in automotive issues. The bears have claimed that automobile companies have been hurt because of a slackening in exports. Reports issued by various companies this week show a decline, but not one that will materially affect sales.

Automobile Securities Quotations on the New York and Detroit Exchanges

	Bid	Asked	Net Ch'ge
*Ajax Rubber Co.	60½	61	+ ½
*J. I. Case T. M. Co. pfd	80	83	+5
Chalmers Motor Co. com	5	9	—2
Chalmers Motor Car Co. pfd	..	..	..
*Chandler Motor Car Co	71½	72½	—8
Chevrolet Motor Co	68	71	—1
Curtiss Aero	38½	40	— ¾
Fisher Body Corp. com	37	38	+6
Fisher Body Corp. pfd	85½	89	—1
Fisk Rubber Co. com	102	105	+37
Fisk Rubber Co. 1st pfd	96	102	+4
Fisk Rubber Co. 2nd pfd	90	95	+2
Firestone Tire & Rubber Co. com	115	117	—1
Firestone Tire & Rubber Co. pfd	102½	103½	..
*General Motors Co. com	92¾	93	—4½
*General Motors Co. pfd	81	83	—1
*B. F. Goodrich Co. com	43⅞	45	—2⅛
*B. F. Goodrich Co. pfd	101	106	..
Goodyear Tire & Rubber Co. com	189	191	—3
Goodyear Tire & Rubber Co. pfd	103	104	—2
Grant Motor Car Corp	2	4	—1
Hupp Motor Car Corp. com	2½	3½	..
Hupp Motor Car Corp. pfd	80	85	..
International Motor Co. com	7	12	—6
International Motor Co. 1st pfd	..	40	..
International Motor Co. 2nd pfd	15	30	..
*Kelly-Springfield Tire Co. com	42	45	—2
*Kelly-Springfield Tire Co. 1st pfd	85	95	—2
*Lee Rubber & Tire Corp	17⅛	18	—1⅜
*Maxwell Motor Co., Inc. com	31⅛	32	— ⅛
*Maxwell Motor Co., Inc. 1st pfd	63⅞	64½	—2⅛
*Maxwell Motor Co., Inc., 2nd pfd	..	..	..
Miller Rubber Co. com	175	180	..
Miller Rubber Co. pfd	101	102	—1
Packard Motor Car Co. com	145	155	..
Packard Motor Car Co., pfd	96	98	..
Paige-Detroit Motor Car Co	24	26	..
Peerless Truck & Motor Corp.	13	15	..
Portage Rubber Co. com	125	130	—15
Portage Rubber Co. pfd	..	..	..
Regal Motor Car Co. pfd	15	20	..
Reo Motor Car Co	25½	26½	— ½
*Saxon Motor Car Corp	13⅛	13¼	+ ⅛
Springfield Body Corp. com	1	6	..
Springfield Body Corp. pfd	8	18	..
Standard Motor Construction Co	8	9	— ¾
*Stewart-Warner Speed. Corp	56¼	57¼	—1¼
*Studebaker Corp. com	45¾	46	+2
*Studebaker Corp. pfd	..	96	..
Swinehart Tire & Rubber Co	..	50	..
Submarine Boat	16½	18	—8½
United Motors Corp	17⅝	17¾	—1⅜
*U. S. Rubber Co. com	57½	58	—3¼
*U. S. Rubber Co. pfd	103	105	—2
*White Motor Co	43	43½	—2
*Willys-Overland Co. com	27⅛	27½	— ⅜
*Willys-Overland Co. pfd	89	95	—1
Wright-Martin	7⅝	8	—1

*At close September 17, 1917. Listed New York Stock Exchange.

OFFICIAL QUOTATIONS OF THE DETROIT STOCK EXCHANGE

ACTIVE STOCKS

	Bid	Asked	Net Ch'ge
Auto Body Co	..	..	..
Bower Roller Bearing Co	82½	31½	— ½
Chevrolet Motor Co	69	76	+1
Commerce Motor Car Co	..	10	..
Continental Motor Co. com	5¼	5⅝	+ ⅜
Continental Motor Co. pfd	..	..	..
Edmunds & Jones com	..	37	..
Ford Motor Co. of Canada	..	221	..
Hall Lamp Co	..	21	..
Michigan Stamping Co. com	..	..	..
Motor Products	..	..	..
Packard Motor Car Co. com	..	149	..
Packard Motor Car Co. pfd	..	98	..
Paige-Detroit Motor Car Co	..	25⅝	..
Prudden Wheel Co	..	20½	..
Reo Motor Car Co	25¾	26	— ¼

INACTIVE STOCKS

	Bid	Asked	Net Ch'ge
Atlas Drop Forge	..	35½	..
Kelsey Wheel Co	82	..	..
Regal Motor Car Co	..	26½	..

Business Wants War Board With Power To Set Prices

Large Convention at Atlantic City Calls for Closer Cooperation With Government—Old Days Are Past—Business Is Turning To Future

ATLANTIC CITY, N. J., Sept. 19—American business men in session here under the auspices of the Chamber of Commerce of the United States is proving one of the greatest successes of any convention ever called by the chamber. The huge assembly hall in the garden pier here with capacity for over 1500 is crowded at the morning, afternoon and evening sessions by business delegates from every State in the Union. Never before has the chamber been able to bring together such a galaxy of big business interests, all here to get enlightenment on the adapting of different businesses to meet the changed conditions created by the war and all anxious to more clearly know just how they can more honestly serve the country in the present crisis.

Every speaker, including Secretaries Lane and Baker, who addressed the business men yesterday, agree that never before has this country faced such a crisis and never before have there been so many men who have failed to realize the herculean job that we have on our shoulders. Too few business men realize the gravity of the war and too few of them realize the present strength of Germany and the amount of help our allies must have on the western front.

The great needs of Russia to-day and the way in which the United States can aid Russia are in furnishing ships, more ships and still more ships. She is in great need of improved railroad transportation her agricultural methods must be reorganized and she needs a diligently executed restitution of the supply of general commodities, whether manufactured within the country or imported. Railway machinery of all kinds and primarily rolling stock and machinery for repairs; agricultural tractors and harvesting and farm machinery, machine tools and instruments and materials for improving the production within the country are much needed.

Harry A. Wheeler of Chicago, banker and also chairman of the railroad board of the Chamber of Commerce of the United States and founder of the chamber, was given a wonderful ovation and delivered an address on business patriotism that will long be remembered. He declared that business men and transportation men must work hand in hand and that the old order of things, where railroad men are trying to put over things on business men and where business men are trying to put over things on railroad men, must cease.

War Board Advocated

Some suggestion of what business men will have to, and the kind of co-operation business organizations must give the government in the near future, were given by Wadill Catchings, chairman of the committee of the chamber on co-operation with the Council of National Defense at to-day's session of the war convention of the Chamber of Commerce of the United States. The committee advocates the creation of a war board similar to the munitions board in England and declared that until this is done chaos which exists in business to-day will continue to exist.

Order must come out of this chaos if the war is to be won. Mr. Catchings told how the Government planned to spend $19,000,000,000 for itself and the allies in the next year and that some conception of this amount and what it means in business might be obtained by comparison with the complete business turnover of the United States Steel Corp. and all of its subsidiaries which total only $853,000,000 per year.

More Power for War Board

Without any loss of time our Government should be given power to create a war board such as the British Munition Board because at present the war industries board is doing great good, but it is purchasing in Washington, Government supplies just as they are purchased in times of peace, which is wrong. The War Industries Board is doing what it can to get different government departments to make purchases in unison, but is not making that progress which the times demand. The war board should be doing the buying itself and should have power to set prices in those materials necessary for national defense and for the preservation of life. Such a war board would also have power to determine priority in matters of materials and shipments.

Business men at the convention agree that this message of a great war board with powers on a par with the British Munitions Board is one of the great messages of the present convention and one of the imperative problems confronting the nation. Many business interests at present are silently opposed to such a powerful board, but business Washington feels that such a movement must come and that business men one and all must accept it and heartily co-operate in the work.

The old curtain has fallen, the old days are past and they will never return. A new life has come and the eyes of business men and transportation men are turned to the future and not to the past. Mr. Wheeler, in speaking of Federal control of railroads, declared that there must come a time when there will be a greater concentration of power and a greater concentration of control and which will not be opposed by the railroad men but in which they will energetically co-operate. The motto Mr. Wheeler suggested for business men and railroad men in getting together is "What we should do to-day is not why we should not do certain things demanded but rather how we can constructively do such things." He declared that the railroads will undoubtedly have to face practically the same things that the railroads in England are facing today and that after the war nearly $1,000,000,000 per year will be needed to put the railroads in that condition that the times will demand.

He urged that business men accept the fact that they will have to pay for this and that in prosperous times this heavier load should be carried and that it should not be put off to lean years. In closing, Mr. Wheeler delivered a climax which every business man should have printed and framed and hung over his business desk.

Here it is: "Until the principles we have at stake in this war are closer to us than our business we will never be right with our Government."

Lord Northcliffe, chairman of the British War Mission in America, in which capacity he superintends the expenditure of $50,000,000 to $60,000,000 per week for war supplies, told 2500 delegates and business men at to-night's meeting at the war convention held by the Chamber of Commerce of the United States that the present war is a war in which the entire nation and all the industries must be mobilized.

In France and England there are to-day no industries that are not war industries contributing to waging the war. The war is a war of manufacture, of transportation and distribution, and is essentially a business man's war.

Lord Northcliffe cannot see a very speedy end to the war as Germany has been preparing for it since the days of Frederick the Great and it is impossible to vanquish her in three or four short years.

Lord Northcliffe told of many of the practical things England did in the present war, the first of which was adding an hour of daylight, which has, after months of trial, given good satisfaction. England found in the early days of the war that you cannot work labor seven days a week, but you can start one hour earlier each day. A hopeful aspect of the war is that it does much good in making people more thrifty in saving food, more thrifty in conserving labor, and has resulted in new machinery being devised, in great progress in medical surgery, in dentistry, in sanitation and in many other sciences.

Lord Northcliffe thinks that the United States is just where England was two and a half years ago, in that business has not adjusted itself to the war. We must learn that every business in the country can be used for the war. Furniture makers have now to build the framework for airplane wings, and automobile builders have to manufacture airplanes, ordnance and farm tractors.

Lord Northcliffe concluded by saying that Paris is to-day more normal than since the early months of the war and that Italy has one of the finest and best equipped armies in Europe.

U. S. Control of Oil Unlikely

Bedford Says Oil Plentiful—Need for Men and Money

ATLANTIC CITY, N. J., Sept. 19—The supply of crude oil for the production of gasoline and lubricating oils is sufficient for the next 5 years providing the production of crude is kept up as at present, but while the situation with regard to the gasoline supply or the crude either is not grave, it does demand very serious consideration. In these words A. C. Bedford, of New York, president of the Standard Oil Co., summed up the fuel situation in his address before 1000 delegates of the Chamber of Commerce of the United States at its war convention here to-day. Mr. Bedford announced that the supreme problem with regard to crude oil is that supply and prices are not being unduly increased and that the Government has not yet seen fit to enter into the question of price regulation nor will it have to unless something in the nature of a runaway market occurs.

Plenty of Crude

There is a plentiful supply of crude oil in the bowels of the earth and only men in increased numbers and money in greatly increased quantities are needed to increase the supply of crude oil produced from year to year. The price of crude is certain to increase due to the greatly increased price of steel needed for tanks, etc., for storage of it, and also due to the greatly increased cost of labor in the production of crude.

The price of crude in 1915 was 40 cents per barrel. In 1917 it had jumped to $1.70 per barrel, and in August of this year it rose to $2 per barrel, where it is selling at present. There are 25,000 different organizations producing crude, but yet the amount of new crude produced this year in comparison to supply is not so great as it was a year ago. Today the annual supply of crude oil is 312,000,000 barrels, but the demand is 330,000,000 barrels, so that demand is 18,000,000 barrels greater than supply. At the present time there is no shortage of refineries to handle much more crude than is needed; in fact, the capacity of the refineries is 350,000,000 gal. per year. Mr. Bedford paid a fitting tribute to Dr. Wm. Burton, chief chemist of the Standard Oil Co. of Indiana, who invented the cracking process when he declared that had it not been for Dr. Burton's invention and the general use of it there would not be enough gasoline to-day to meet the requirements.

Casing Head Helps

The production of casing head gasoline is helping out very mutually. Approximately 2,500,000 barrels will be produced from this source this year, and next year perhaps 6,500,000 barrels will come from this same source. The present stock of crude oil on hand is being slowly cut into. On Jan. 1 this year the stock of crude in storage was 174,000,000 barrels, and on July 1 it had shrunk to 164,000,000 barrels.

Some conception of the increased demands being made on the supply of gasoline is apparent from the production figures covering the last dozen years.

In 1899 production was 6,000,000 barrels; 1916 production was 45,000,000 barrels; 1917 production 50,000,000 barrels. Notwithstanding the greater home demands on the crude supply and also for gasoline, the United States will give all the Allies all the gasoline and crude that are needed for the successful carrying on of the war. In 1915 over 5,000,000 barrels of gasoline were exported to them. In 1917 our exports will total over 7,000,000 barrels, and during the next 12 months we will export over 8,000,000 barrels.

Mr. Bedford declared that the petroleum interests had pledged their undivided loyalty to the nation and that there would not be any politics in regard to the fuel situation as related to petroleum and its products, but that all buried political motives and were co-operating in the supreme work of winning the war. Mr. Bedford declared that petroleum was next to coal in importance due to the great amount of petroleum products to be used in aviation, motor vehicles, motor boats, etc.

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Westinghouse Generators on 1918 Trucks

PITTSBURGH, Sept. 15—The Locomobile, Pierce-Arrow and Garford companies will use the Westinghouse electric generators on their 1918 trucks. This generator was designed to meet the specifications of the U. S. Government for military truck service. This generator will also be installed on the 1918 Mercer, making its lights completely independent of the battery.

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Mackaye Made Ross Receiver

DETROIT, Sept. 14—H. D. W. Mackaye, general manager of the Ross Automobile Co., has been appointed temporary receiver of the company and a creditors committee has been appointed including Frank Lawrence, of the A. O. Smith Co., Louis Smith, of the Griswold Body Co., and A. J. Fisk, of the Robbins-Myers Co. It is believed that through the appointment of a friendly receiver all creditors will receive their claims in full.

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American Ball-Standard Parts Deal Closed

CLEVELAND, Sept. 19—The Standard Parts Co. has acquired 100 per cent of the stock of the American Ball Bearing Co. The deal is closed, but the price is not yet determined because the Standard Parts Co. is awaiting results of the valuation. The Standard Parts Co. will pay its own common stock at full value for the stock of the American Ball Bearing Co. at its book value. The Standard Parts common book value is understood to be little over $100 a share.

Car Tax Revised and Lowered

3 to 4 Per Cent on Makers—Owners and Truck Companies Excluded

WASHINGTON, Sept. 18—The Senate and House conferees on the war revenue bill on Tuesday reached a tentative agreement under which the automobile tax on manufacturers as proposed in part in the original House bill be accepted in lieu of the Senate provision taxing each automobile owner. The 5 per cent manufacturers' tax, however, was not acceded to. This agreement Tuesday contemplates a compromise as follows:

Machines selling for less than $500........$15
Machines selling between $500 and $750... 20
Machines selling between $750 to $1,000... 25
$5 additional for each additional $250 in Selling Cost.

Motor trucks would be exempt under the provision. On Monday it was proposed to tax the makers 3 per cent on the manufacture of passenger cars and cars held by dealers with no tax on owners or on motor truck manufacturers.

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Fulton Interested in American Brass Co.

MILWAUKEE, Sept. 15—The American Brass Foundry Co., maker of the American bumper and other automobile accessories, has changed its name to the American Metal Parts Co. There will be no change of policy or personnel except that S. A. Fulton, president of the Fulton Co., this city, manufacturer of automobile accessories, has purchased an interest in the company and is now an officer and director of the company. The entire sales of American bumpers and other products will be handled exclusively by the Fulton company.

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Chandler Curtiss Engine Inspector

DETROIT, Sept. 19—Bill Chandler, formerly head of the Hudson racing team, is inspecting airplane engines for the Curtiss Aeroplane Company.

Two Continental Truck Engine Sizes

DETROIT, Sept. 19—The Muskegon plant of the Continental Motors Corp. will soon be manufacturing two sizes of truck engines designed at Muskegon and in accordance with standardized Government specifications for transport service trucks for the United States army.

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Perrin Joins Signal Corps

WASHINGTON, D. C., Sept. 17—J. G. Perrin is now working with Colonel Clark on the design of parts for standard airplanes. Perrin will take entire charge of the engineering work of this department and will have offices at 119 D Street, Washington.

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DIVIDENDS DECLARED

General Aluminum & Brass Mfg. Co., quarterly of 8 per cent and 2 per cent extra, paying Sept. 20 to stock of record Sept. 15.

Factory

Grant Makes Plant Addition

CLEVELAND, OHIO, Sept. 14—The Grant Motor Corp. will erect an 875 by 60 ft. addition to its plant at a cost of $750,000. It will be four stories high and built in units. This addition has been made necessary by the acquisition of the Denneen Motor Co., makers of Denmo trucks.

Kempsmith to Enlarge Again

MILWAUKEE, WIS., Sept. 17—The Kempsmith Mfg. Co. has increased its capital stock from $300,000 to $350,000 to accommodate its increased business. At the same time it is announced that the plant will be enlarged for the third time within 12 months by the erection of a brick and steel shop addition, 101 x 210.

Another Building for Davis

MILWAUKEE, Sept. 17—The Davis Mfg. Co. has awarded contracts for the erection of a new core building, 92 x 100, to supplement the new machine shop and foundry additions now being completed.

Oneida Starts Building

GREEN BAY, WIS., Sept. 17—Work has been started on the erection of the new plant of the Oneida Motor Truck Co., Green Bay, Wis., which has been manufacturing trucks in leased quarters on a small scale for about six months. The main factory, now under construction, will be 150 x 476. It will employ between 200 and 250 men.

Doubles Lighting Equipment Plant

OSHKOSH, WIS., Sept. 17—The Universal Motor Co., manufacturing electric lighting units, will double the size of its plant at once to handle several large contracts recently booked and said to be from the government.

International Harvester Expands

MILWAUKEE, Sept. 17—The International Harvester Co. of America will build a new core building costing $100,000 in this city. The big foundry recently was enlarged in size and makes necessary the greatly increased coremaking facilities.

1000 Tires a Day Is Gillette Aim

EAU CLAIRE, WIS., Sept. 17—The Gillette Rubber Co., Eau Claire, Wis., has reached a stage in the construction and equipment of its new plant to enable it to produce 250 casings and 400 tubes a day. By Dec. 1, the output will have been increased to 1000 tires and tubes daily. The present working force numbers 200 men, which will be increased to 750 by Feb. 1.

More Room for Cutler-Hammer

MILWAUKEE, Sept. 17—The Cutler-Hammer Mfg. Co., Milwaukee, is finishing the first unit of the complete reconstruction of its immense plant, and will award contracts within a few days' time for the erection of the second unit. The units are seven stories high, 50 x 200, of reinforced concrete, brick and steel, with steel sides, and each will cost approximately $250,000.

Landover Truck Soon Ready

MENOMINEE, MICH., Sept. 15—The Landover Truck Co., which has organized in this city, as was announced in a recent issue of THE AUTOMOBILE AND AUTOMOTIVE INDUSTRIES, is completing the repairs and machinery installation in its factory here and will commence production shortly. The company plans to sell $500,000 worth of stock.

Lansing Forge Buys Emergency Co.

LANSING, MICH., Sept. 17—The Emergency Drop Forge Co. was purchased from the receiver yesterday by the Lansing Forge Co. with articles of incorporation filed for $100,000. The new concern takes immediate possession of the plant. The capital of $100,000 is all paid in and was supplied by Pennsylvania capitalists.

Officers to Train at Four Wheel Plant

MILWAUKEE, WIS., Sept. 18—A training school for officers in the transportation division of the quartermaster's department of the United States Army is to be established in connection with the big plant of the Four Wheel Drive Auto Co. at Clintonville, according to reports from that city. The company is filling an order for 3750 class B trucks, and it is said the plan contemplates the distribution of quartermaster officers in various departments of the plant as regular mechanics, who will move about to gain experience in every part of the work. Heads of the various departments are to give lectures and provide other intensive instruction relative to the construction, repair and maintenance of army trucks. The course, it is said, will require about 8 weeks.

Doble-Detroit Steam Motors Co. has consummated a lease for a large factory in Detroit and will take possession of the buildings Oct. 1. The plant has 52,000 sq. ft. of floor space and allows sufficient room for additional building if necessary. The company expects to start delivery early in January with a schedule of 2500 cars for the first year.

Dayton-Wright Airplane Co., Dayton, Ohio, organized last May to build airplanes, has purchased a factory owned by the Enterprise Carriage Co., and will start manufacturing in the near future. Between 300 and 500 men will be employed.

Orville Wright, president of the new company, left the Wright-Martin Airplane Co., of which he was vice-president, the early part of this year to form not only the above company, but also the Wright Field Co., the former having a capital of $500,000 and the latter $10,000. The Field company was formed to conduct an aviation school to work in cooperation with the United States Army, in training military aviators.

Olds Motor Works, Lansing, Mich., is erecting a building for storage and inspection, and a building 80 ft. by 400 ft., three stories high with an "L" 80 ft. by 90 ft., for assembly work. The company plans a new assembly system which with the new structures will allow a production of 33,000 cars per year. A new warehouse 400 ft. by 80 ft. has just been completed.

Townsend Mfg. Co., Janesville, Wis., recently incorporated for $125,000 to take over the tractor, farm machinery and implement business conducted for the past year or more by Townsend Brothers, will build a machine-shop extension, 50 by 200 ft., which will enable it to double its output. A production of 200 engines and 600 tractors is planned for the coming year. R. B. Townsend is president and general manager.

Ajax Rubber Co., London, Ont., will build and equip with machinery and manufacturing accessories a plant to cost at least $300,000, in which it will manufacture 900 tires daily, and employ 250 hands.

Weaver Mfg. Co., Springfield, Ill., will erect a one-story brick addition, 95 by 125 ft., which will be devoted to the manufacture of automobile specialties.

Ford Motor Co., of Canada, Limited, has purchased additional land near its plant, Ford, Ont., and is contemplating extensive additions.

Goodyear Tire & Rubber Co., Akron, Ohio, is adding a large swimming pool to its athletic field known as Seiberling Park. The company will erect a large bath house as soon as the swimming pool is complete.

Frick Co., Waynesboro, Pa., has broken ground for the building in which is to be manufactured its new gas tractor. The building will be of brick, 60 x 90 ft., and two stories.

Convertible Tractor Corp. has moved its offices to its new plant, 1485-1489 Marshall Avenue, St. Paul.

Gammon Motor Co., Newark, N. J., manufacturer of tools and fastenings, has leased a three story plant at Mulberry and Murray streets, for manufacturing purposes.

Personals

A. C. Woodbury, who for the past two years has held the position of recorder of standards of the Society of Automotive Engineers, has resigned. Mr. Woodbury has not yet formed a new connection.

W. L. Agnew, formerly director of advertising for the Chalmers Motor Co., is in Detroit following his vacation and will soon announce his plans for the future.

G. B. Allen, assistant chief engineer of the Liberty Motor Car Co., Detroit, has been appointed First Lieutenant of the Ordnance Officers' Reserve Corps of the United States Army, and has been ordered to report for duty at the plant of the Nash Motors Co., as an instructor and inspector in the motor transport department.

E. M. Delling, formerly chief engineer of the Mercer Automobile Co., is chief of inspection for the Saxon Motor Car Corp., Detroit.

Major J. G. Vincent, Chief Engineer of the Equipment Division of the Signal Corps of the United States Army, is in Detroit in consultation with manufacturers who will make the Liberty motor in the Detroit district.

James Guthrie, consulting engineer, has been appointed Major in the Ordnance Department, Field Artillery Section of the Carriage Division of the United States Army, and will report in Washington for service Oct. 1.

Paul D. Burress, factory representative of the Maxwell Motor Sales Corp., has been appointed inspector for the Government, and was ordered to report for duty at the Nash Motors Co. at Kenosha.

Frank A. Kapp has been appointed advertising manager of the Mitchell Motors Co., Racine, Wis. Mr. Kapp was formerly in the advertising department of the Willys-Overland Co.

H. C. Wildesen is the new manager of the export department of the Champion Spark Plug Co., Toledo. He will make his headquarters at the main office in Toledo.

Marvin W. Moesta, who was formerly associated with the Continental Motor Co., Detroit, has joined the Curtiss Aeroplane Co. in the engineering department and will take up his new duties at once.

Williard S. French has been appointed director of sales of the Monarch Governor Corp., Detroit. Mr. French was previously advertising manager of the Danby Truck Co.

P. D. Sampsell, of Syracuse, N. Y., has been appointed district representative for the United States Motor Truck Co. Mr. Sampsell will shortly open offices in Indianapolis and make that city his headquarters.

David Jeidell has joined the Delion Tire & Rubber Co. and will be at the main office, 1922 Broadway, New York. Mr. Jeidell is prominent in advertising and publicity circles. New dealers will be created for the company's territorial distributors and dealer co-operation will be extended by means of Dealers' Helps, which will be supplied to Delion throughout the country.

B. J. MacMullen, formerly of the Willys-Overland Co., has been appointed salesmanager of the Chevrolet Motor Co., of Texas, with headquarters at the Fort Worth territory. Mr. MacMullen succeeds B. C. Bradford, resigned.

William T. Burns is tractor engineer for the Timken-Detroit Axle Co., Detroit. Mr. Burns was formerly associated with the late Hugo Munsterberg, of Harvard University.

C. C. Hope, assistant secretary of the Detroit section of the Society of Automotive Engineers, has resigned to take up work with the War Department in the office of the Inspector of Ordnance. O. M. Brede, formerly manager of the service claims department of the Scripps-Booth Corp., succeeds Mr. Hope.

S. E. Batten has been appointed state representative for Ohio and E. R. McLaughlin has been appointed state representative for Pennsylvania for the Royal Motors Corp., Detroit, and will establish agencies in those cities.

Victor B. Luther has been promoted to chief of the sales accounting department of the Emerson-Brantingham Implement Co., Rockford, Ill. He was formerly head of the accounting department. He will be succeeded by J. C. Musselman.

George C. Heinrici, assistant manager of the Emerson-Brantingham Implement Co., Rockford, Ill., has resigned to become associated with the Oakland Motor Car Co., Pontiac, Mich.

E. B. Hotchkiss, of the American Steel Export Co., New York, sailed Aug. 28 for France. Mr. Hotchkiss will visit France, Italy and Spain in connection with a number of large engineering problems.

A. J. Rogers, advertising manager of the Nordyke & Marmon Co., Indianapolis, has resigned to become a lieutenant in the United States Army.

P. F. Minnock, who has been manager of the Ford factory branch at Columbus, Ohio, has been made manager of the Des Moines Ford factory branch, succeeding F. B. Norman. Mr. Norman has gone into business for himself and taken the Ford city agency at Wilmington, Del. H. M. Barton remains as assistant manager at the local factory branch.

New Companies

MONTREAL, QUE., Sept. 17—The Dominion Carriage Co., Ltd., has been incorporated with a capital stock of $500,000, by Pierre T. Legare, Joseph H. Fortier, Pierre C. Falardeau, and others, all of Quebec, Que., to manufacture automobiles, carriages, vehicles, machinery, implements.

CLEVELAND, Sept. 14—The Glenn L. Martin Co. has been incorporated with a capital of $2,500 to manufacture airplanes and hydroplanes. Glenn L. Martin, the pioneer inventor, recently severed connections with the Wright-Martin Aircraft Corp., of which he was a vice-president, and opened negotiations about the middle of August with local capitalists to start airplane manufacturing. It is expected that the above capital will eventually be raised to $2,500,000.

The incorporators include Charles E. Thompson, president of the Steel Products Co.; S. L. Mather, director of the United States Steel Corp.; Glenn L. Martin, C. H. Osborne and Alva Bradley.

GREEN BAY, WIS., Sept. 17—The Cluley Multiplier Co., of Green Bay, Wis., which has been manufacturing the Cluley adding, subtracting, multiplying and dividing machine for a year or more, has engaged in the production of motor car parts and accessories, pending the further development of the multiplying machine. The list of new products includes a dimmer, headlight reflector, automatic air pump for tire inflation, tire mileage meter, automatic jack, and a superheated manifold, all invented and designed by John P. Cluley, manager of the company and inventor of the multiplying device.

PRAIRIE DU CHIEN, WIS., Sept. 10—James F. Tanner, Springfield, Ill., and E. A. Tanner, Delta, Ia., are establishing a plant in Prairie du Chien, Wis., for the manufacture of black walnut

stock for airplane frames. The Tanners are said to hold contracts with Government contractors on the basis of $75 per 1000 ft. of airplane stock. The airplane stock must be 1 in. thick, 8½ in. wide and 10 to 12 ft. long as a minimum.

Master Driver Run Oct. 11-13

CHICAGO, Sept. 14—A third annual contest for awarding the title of Master Driver of the Chicago Automobile Club, has been arranged for Oct. 11, 12 and 13. It is planned to run into Wisconsin from Chicago, the first night control being at Oshkosh, and the second night control at Milwaukee. A limit of twenty has been placed on the entry list.

Cole and Kissel in Three-Cornered Deal in New York

NEW YORK, Sept. 15—Important changes are slated for automobile dealers' row Oct. 1. For instance, the Colt-Stratton company, which has been handling the Cole and the Dodge cars, will drop the former, which is to be taken by Russel L. Engs, handling the Kissel. Mr. Engs will drop the Kissel car as a result of the deal. It is stated on good authority that the Kissel distribution will be taken by one of the leading dealers, who does not for the present wish to have his name divulged.

Rubber Shippers Seek Lower Rates

AKRON, Sept. 15—The Northeastern Ohio Rubber Shippers' Assn., recently formed, does not plan any extended campaigns for rate reductions at present and will operate on the defensive basis rather than on the offensive. The association is seeking readjustment on rates on crude rubber which were increased unjustifiably, according to the association, by carriers in March, 1910.

Duesenberg Wins at Providence

PROVIDENCE, R. I., Sept. 15—About 100,000 attended to-day's races at the local speedway, two of the three events being won by Milton in a Duesenberg. The 100-mile event was a close race, the winner, Milton, passing the leader, Vail, in a Hudson, in the last turn of the last quarter mile. The winners in the different events follow:

Position	Driver and Car	Time
	5-MILE EVENT	
1	Mulford, Frontenac	3:58:83
2	L. Chevrolet, Frontenac	3:59:30
3	Milton, Duesenberg	3:59:40
4	Boyer, Frontenac	4:00:30
	25-MILE EVENT	
1	Milton, Duesenberg	19:46:00
2	Vail, Hudson	20:07:55
3	L. Chevrolet, Frontenac	20:22:20
4	Hearne, Duesenberg	21:20:77
	100-MILE EVENT	
1	Milton, Duesenberg	1:24:42:25
2	Vail, Hudson	1:24:44:80
3	Hearne, Duesenberg	1:25:46:15
4	Lewis, Hoskins	1:27:36:15

Calendar

ASSOCIATIONS

Oct. 9-11—Pittsburgh National Assn. of Purchasing Agts., Convention.

Oct. 9-11—Chicago, National Federation of Implement and Vehicle Dealers' Assn., 18th Annual Convention, Hotel Sherman.

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Jan. 3-4—New York, Automotive Electric Assn., meeting.

CONTESTS

Sept. 22—Allentown, Pa., Track Race.

Sept. 22—New York Speedway Race.

Sept. 28—Trenton, N. J., Track Race.

Oct. 6—Danbury, Conn., Track Race.

Oct. 6—Uniontown, Pa., Speedway Race.

Oct. 11-12-13—Chicago, Master Driver contest.

Oct. 13—Richmond, Va., Track Race.

Oct. 13—Chicago Speedway Race.

Oct. 27—New York Speedway Race.

Oct. 24—Columbus, Ohio, Dixie Highway tour.

SHOWS

Sept. 17-24—Grand Rapids, Show, Automobile Business Assn. State Fair, West Allis, Milwaukee Automobile Dealers.

Sept. 18-21—Toronto, Annual Tractor Show, Canadian National Exhibition.

Sept. 18-22—Los Angeles, Cal., Second Annual Tractor Demonstration, Tractor Engine and Implement Dealers' Assn. of Southern California.

Sept. 18-22—Reading, Pa., Automobile Show at Fair, Reading Automobile Dealers' Assn.

Oct. 1-6—Buffalo, N. Y., Closed Car Show, Automobile Dealers' Assn., Elmwood Music Hall.

Oct. 1-13—Wichita, Kan., Show.

Oct. 6-13—Boston, Closed Car Show, Boston Automobile Dealers' Assn.

Oct. 6-13—Cincinnati Automobile Show, Music Hall, Cincinnati Automobile Dealers' Assn.

Oct. 13-28—Dallas, Tex., Dallas Automobile & Accessory Dealers' Assn., State Fair.

Nov. 12-18—Denver, Colo., Show, Auditorium, Automobile Trades Assn. of Colorado.

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Jan. 5-12—New York Show, Grand Central Palace, National Automobile Chamber of Commerce.

Jan. 19-26—New York, Motor Boat Show, Grand Central Palace, National Assn. of Engine and Boat Manufacturers.

Jan. 19-26—Montreal, Show, National Motor Show of Eastern Canada, Montreal Automobile Trade Assn.

Jan. 26-Feb. 2—Chicago National Show, Coliseum and Armory, National Automobile Chamber of Commerce.

S. A. E. Calendar

Standard Division Meetings

September

18—Data Sheet, New York.
24—Aeronautic, Munsey Bldg., Washington, D. C.
26—Marine, New York.

October

3—Miscellaneous, Detroit.
4—Lighting, Detroit.
5—Miscellaneous, Congress Hotel, Chicago.
6—Tractor, Congress Hotel, Chicago.

Engineering

American Railway Master Mechanics' Assn.
American Institute of Electrical Engineers.
Master Builders' Assn.
American Society of Heating and Ventilating Engineers.
Association Iron and Steel Electrical Engineers.
Mining and Metallurgical Society of America.
Society of Automotive Engineers.
Illuminating Engineering Society.
National Electric Light Assn.
National Gas Engine Assn.
American Society for Testing Materials.
American Institute of Metals.
American Foundrymen's Assn.
Society Naval Architecture and Marine Engineers.

SEPTEMBER

20—Mining & Met. Soc. of Amer. monthly meeting N. Y. section at Engrs. Club.

24—Amer. Inst. Metals at Boston.

24—Amer. Fdry. Assn. annual meeting at Boston.

OCTOBER

6—Assn. Iron & Steel Elec. Engrs. monthly meeting Phila. section.

8—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Ill. section at Chicago.

9—Amer. Soc. Heat & Vent. Engrs. monthly meeting Mich. section at Detroit.

10—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Mass. section at Boston.

11—Amer. Soc. Heat & Vent. Engrs. monthly meeting Penn. section at Phila.

13—Assn. Iron & Steel Elec. Engrs. monthly meeting Cleveland section.

15—Amer. Soc. Heat. & Vent. Engrs. monthly meeting New York section.

17-18-19—Amer. Gas. Inst. at Washington, D. C.

18—Mining & Met. Soc. Amer. monthly meeting New York section Engrs. Club.

20—Assn. Iron & Steel Elec. Engrs. monthly meeting Pittsburgh section.

NOVEMBER

3—Assn. Iron & Steel Elec. Engrs. monthly meeting Phila. section.

8—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Penn. section at Phila.

9—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Ohio section at Cleveland.

10—Assn. Iron & Steel Elec. Engrs. monthly meeting Cleveland section.

12—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Ill. section at Chicago.

12—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Mich. section at Detroit.

13—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Mass. section at Boston.

15—Mining & Met. Soc. Amer. monthly meeting New York section at Engrs. Club.

15-16—Soc. Naval Arch. & Marine Engrs. annual meeting.

17—Assn. Iron & Steel Elec. Engrs. monthly meeting Pittsburgh section.

19—Amer. Soc. Heat. & Vent. Engrs. monthly meeting New York section.

DECEMBER

1—Assn. Iron & Steel Elec. Engrs. monthly meeting Phila. section.

8—Assn. Iron & Steel Elec. Engrs. monthly meeting Cleveland section.

10—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Ill. section at Chicago.

11—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Mich. section at Detroit.

13—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Penn. section at Phila.

13—Amer. Soc. Heat. & Vent. Engrs. monthly meeting Ohio section at Cleveland.

15—Assn. Iron & Steel Elec. Engrs. monthly meeting Pittsburgh section.

17—Amer. Soc. Heat. & Vent. Engrs. monthly meeting New York section.

20—Mining & Met. Soc. Amer. Monthly meeting New York section at Engrs. Club.